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JANUARY TO DECEMBER, 1919

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INTERNATIONAL

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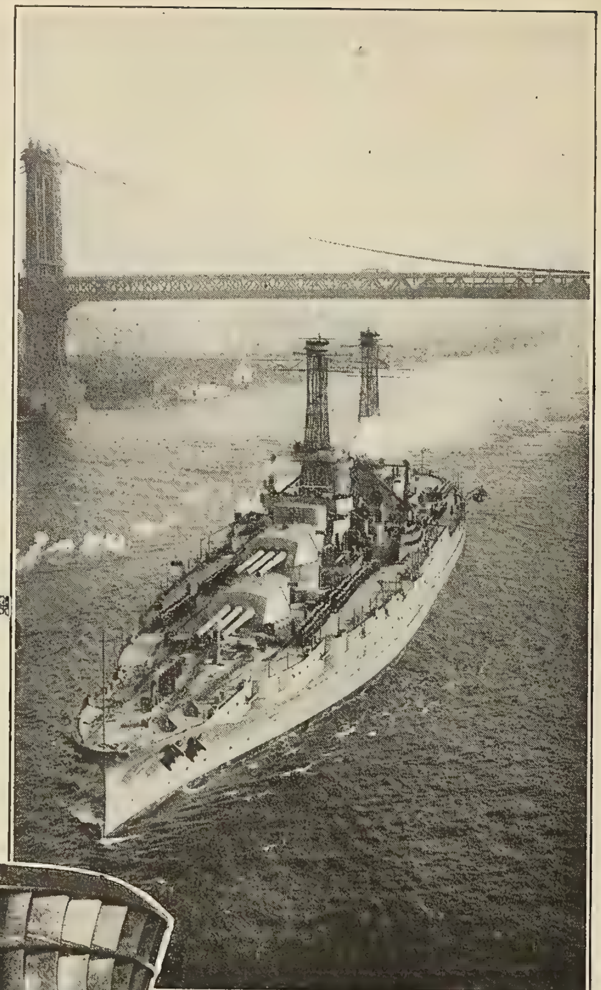

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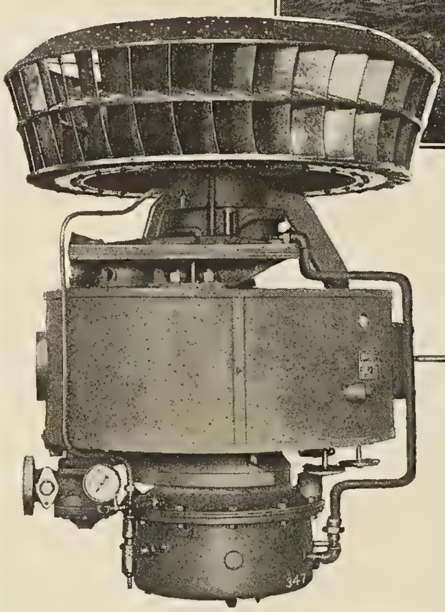

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America's Opportunity

WITH the exception of her navy, now the second largest in the world, the United States has not scored heavily in recent years as a maritime nation. In overseas commerce, American ships have been a negligible factor. Shipbuilding has been limited to the needs of our protected coastwise trade, the commerce on the Great Lakes and inland waterways and the requirements of our navy. Due to the failure of the Government to enact legislation to enable the merchant marine to compete with the more cheaply operated vessels of foreign nations, the American flag has been practically driven from the high seas.

But with the advent of war the folly of ignoring our maritime interests has been so strongly driven home that further negligence in this respect is unthinkable. The emergency fleet, now being created at enormous expense under war conditions, places a new responsibility upon the nation. The future of American shipping has become one of the great national problems that will require an immediate solution. The Controller General of Merchant Shipbuilding in Great Britain does not hesitate to predict that too many ships cannot be built in the next ten years and that all tonnage produced in the next five years will be fully occupied without leading to trade wars or dangerous rivalries.

With such prospects in view, can we afford to delay in shaping a definite policy for the upbuilding and maintenance of American shipping in foreign trade?

American Shipbuilding in 1918

TO those who a year ago enthusiastically predicted an output of about 6,000,000 deadweight tons of merchant shipping from American shipyards in 1918 the results will undoubtedly be disappointing, but it will be remembered that at the same time experienced shipbuilders voiced the opinion in these pages that if things did not break too badly the shipbuilding industry of the United States might turn out 3,000,000 deadweight tons of merchant shipping during the year. As the total production in 1917 was about one and a quarter million tons, this meant an addition of about two million tons in a year, a rate of expansion which no nation had hitherto succeeded in attaining. As matters have turned out, this conservative estimate has been so nearly accurate that the difference is negligible.

According to the incomplete returns supplied by the Shipping Board, published elsewhere in this issue, an output of 3,000,000 deadweight tons was reached early in December. About 48 percent of the tonnage was produced on the Pacific coast, 28 percent on the Atlantic coast, 22 percent on the Great Lakes, and 2 percent on the Gulf coast. Of the total tonnage delivered to the Shipping Board, 87 percent was steel, 12 percent wood, and 1 percent composite construction. The largest output was from the five great yards of the Bethlehem Shipbuilding Corporation, Ltd., on the seacoasts, and the second largest from the yards of the American Shipbuilding Company on the Great Lakes. The largest cargo vessel delivered during the year was a turbine-driven steel steamer of 12,500 tons built at the Pennsylvania plant of the Pusey and Jones Company, while the average size of steel cargo vessels produced was 8,800 tons deadweight.

As far as the production of steel vessels requisitioned by the Shipping Board is concerned, the actual deliveries came within about 3 percent of the required schedule, but the output of steel contract vessels fell 54 percent behind the schedule and the output of wood vessels represented a failure of 80 percent. The failure of contract steel ship deliveries is accounted for by the delay in the work at the three great yards built by the Government for the assembly of fabricated ships, from which a production of over a million tons was scheduled by January 1.

In spite of the failure to meet the Shipping Board schedule, which was not unexpected, the American merchant marine is to-day expanding more rapidly than that of any other nation in the world. In August the United States became the leading shipbuilding nation in the world. It now has more shipyards, more shipways, more shipyard workers, more ships under construction, and is building more ships every month than any other country, not excepting the United Kingdom, which hitherto was the first shipbuilding power. And so far the effect of the fabricated ship programme has hardly been felt. In the coming months this will add enormously to the output of merchant shipbuilding.

Port and Harbor Facilities

OF vital importance to the development of the American merchant marine and the expansion of our foreign trade is the immediate provision of adequate pier and cargo handling facilities at the principal ports. Steamship companies are complaining of the congestion at New York, where the heaviest volume of overseas trade is handled, while the port authorities in Philadelphia, which stands second in the volume of traffic handled, claim that their facilities are not being used to more than fifty percent of their capacity.

The Port and Harbor Facilities Commission of the Shipping Board, composed of E. F. Carry, chairman; Major-General W. M. Black, U. S. A.; Colonel Bion J. Arnold, U. S. A.; Dr. J. E. Greiner, of Baltimore; H. McL. Harding and Calvin Tomkins, of New York, and John Meigs, of Philadelphia, is endeavoring to work out a consistent plan for enabling the country not only to use all of its available port facilities to their full capacity but

also to develop them to a higher efficiency and to provide additional facilities of the very best type. A thorough investigation has been started as to harbor and terminal facilities in every port as well as of the comparative cost and efficiency of various methods of handing cargoes (with special reference to mechanical freight handling appliances) and the needs for bunkering, repair and dry docking facilities. So far the commission has recommended to the Shipping Board the construction of dry docks or marine railways and commensurate repair plants at Boston, New York, Philadelphia, Norfolk, Pensacola, Astoria, Seattle, Portland, San Francisco and Los Angeles and has secured authorization for the immediate construction of two 20,000-ton and eight 10,000-ton floating dry docks, which are to be located in the ports where the need is most urgent. But the provision of adequate repair and dry docking facilities, essential as it is (rated first in importance by the Controller General of British Shipbuilding), is only one of the needs in port development in the United States that requires immediate attention. By far the most pressing need is the improvement of cargo-handling facilities, so that both present terminals and future additions can be utilized at higher capacities.

Great Britain is facing the same problem, and in an address delivered at a recent meeting of the Institution of Civil Engineers, Sir John A. Aspinall, president of the Institution, pointed out the lack of mechanical equipment at important British seaports, recommending the following methods of supplying the deficiency:

"It must be remembered that the problem of loading and discharging ships is by no means the easy matter which some people suppose, and the very difficulties—not of a mechanical nature—make it the more necessary to have quick and cheap handling of freight so that every farthing per ton can be saved in manipulation, and pier space, which is always costly, can be rapidly cleared. Customs regulations require examination of imported goods, and nearly everything taken out of the ships must be put down on the ground to be looked at, and this alone necessitates double handling.

"Exports again cannot always be put on board ship at the moment of arrival alongside, as a vessel to call at many ports must have her cargo in systematic order, not only in the order of the ports, but also in relation to the character and weight of the articles exported. This means storage in transit sheds before loading and the picking out, sorting and lifting, very often twice over, of the goods which have arrived. All of these little points add to the necessity of eliminating hand labor and doing by quick-acting machinery that which is necessary to hurry the vessel away to sea, and thus increase the number of voyages per annum.

"Electric overhead travelers, such as are now used in most modern railway transit sheds, with a longitudinal traverse of 450 feet per minute, and a cross and lifting speed of 150 feet per minute, are probably the most suitable appliances for this work inside the sheds, while outside there should be a liberal supply of quick-acting jib cranes. At the most modern railway freight stations, where the same freight has ultimately to be handled, these quick-acting appliances, in combination with the modern electrically propelled platform trucks, have been the cause of great economies.

"In every case, apart from those where difficulties have been mentioned, cranes and other appliances should load direct from the ship to trucks or railway cars, and from cars to the ship, though it is extraordinary to find how little provision has been made for this direct loading to transport vehicles at many large ports."

Full-Sized Ship Experiments

NUMEROUS cases are on record where good results have been obtained by alterations made to full-sized ships after they have been completed. Trial trips have been run both before and after the alterations, and in this way a trustworthy estimate has been made of the difference in performance.

At the spring meetings of the Institution of Naval Architects in 1917, Sir E. Tennyson d'Eyncourt, for instance, recalled the case of two ships built about seventeen years ago. After they had been in service for some time, he suggested that the bossing, which was nearly horizontal, was not at a suitable angle. On one of the ships coming back to the works, it was therefore decided to alter the angle to something approaching 45 degrees, and, in addition, the casting was fined at the aft end as well as the lines of the bossing itself. At higher speeds, much better results were obtained than with the old horizontal bossing, but the improvement did not maintain itself at lower speeds. This showed that the improvement was due to the angle of the lines. After the ship had been in service for some time it was found that so much coal had been saved that her sister ship was sent to have a similar alteration made to her bossing.

Sir Archibald Denny, at a meeting of the North-East Coast Institution of Engineers and Shipbuilders in November, 1915, instanced a rather curious case of alterations made to a full-sized ship where it was found that the bad performance of the vessel was not due to the suspected cause but to something entirely different. When the vessel was built her bilge keels, which were very long, were not put on normal to the bilge, as they would have been out of the water at the ends, the angle of the diagonal plane of the keel being reduced. When the vessel was tried on the measured mile, her efficiency was found to be very low. Some one suggested that the bilge keels were the cause of the trouble, and a length of 20 feet was cut off from each end of both of them. This causing no appreciable difference, the bilge keels were taken off altogether, and the reduction in the resistance was found as nearly as possible to be quite normal. Later it was seen that there was a lack of surface in the propellers, and when new propellers were put on the efficiency came up to expectations. This, however, did not explain the fact that in an almost identical ship with similar propellers proper results had been obtained, and Sir Archibald Denny has stated that to this day he is not able to explain with certainty why the results were so different. Another case quoted by him was that of a channel steamer. In order to get the maximum result, mastic was placed behind each butt and washed off into the general surface. This was done for some years, but when the mastic cracked off it was not replaced, because there was no apparent differences in the speed on service with or without it.

Admiral Taylor, in his "Speed and Power of Ships," refers to the steamer *Niagara*, a yacht about 250 feet long, in which the shaft brackets were nearly horizontal. She was given two six-hour trials under similar conditions. In the first the screws were inward-turning, and in the second were interchanged to be outward-turning. The horsepower developed on each trial was very nearly the same, but with the inward-turning screws the average speed was 12.8 knots, whereas it was 14.12 knots with outward-turning screws.

Admiral Dyson, the propeller designer of the United States Navy, has instanced a case of two oil-fuel barges built for the Navy Department. These vessels were designed for a speed of six knots, and everything indicated

that the speed could be easily obtained with the power. After trying several different propellers, however, the highest speed realized was only 5¼ knots. It was thought that the action of the water indicated that a portion of the feed was being drawn from astern, and, as the cheapest remedy, the line of shafting was changed so as to lower the propeller about 3 feet, although the lower blade projected below the line of keel. In this new position, with propellers of the same pitch and surface but of 5 inches greater diameter, a speed of 6¼ knots was obtained with the same power as before. The greater portion of this increase in efficiency of the propeller was due to increase in diameter, and the remainder to the change in position, but the increase in diameter was rendered possible by the lowering of the shaft.

Many other examples could be given, but those mentioned are sufficient to show the benefits that may be derived by making alterations in consequence of careful observations of a ship's behavior in service. The cost of carrying out the alterations must vary, and in some cases will no doubt amount to a fair figure. On the other hand, the large saving brought about by the reduced fuel consumption, which operates during the whole lifetime of a ship, will more than balance even a considerable outlay on such alterations. When this is generally realized, it can be confidently stated that enormous economies will be effected in ship propulsion.

The British Standard Ship

THE standard ship now being built in British shipyards to make good the loss of tonnage due to submarine warfare is of about 8,000 tons, and all the ships already laid down are of identical pattern. Eight thousand tons seems to have been hit upon as a middle size between 6,000 and 10,000 tons. An 8,000-ton ship shares with the 6,000-tonner the ability to enter virtually any port—a matter of considerable importance—and it has this advantage over the 10,000-tonner, that for every 40,000 tons built, the risk of loss is divided among five ships instead of four. An eye has also been kept on the after-war value of the ships, and it is claimed that the owner who would prefer either a 6,000- or 10,000-ton ship could without much inconvenience put up with a ship to carry 8,000 tons of coal or grain.

There is, of course, no question of the capacity of the shipyards to make good the wastage of merchant ships when their energies are turned in that direction. The trouble has been to get the rolling mills to turn out the plates and sections with the necessary quickness. The standardization of a large number of ships will permit the rolling mills to work for long spells without alteration of the machinery, and this will greatly increase the output.

The North-East Coast Engineers have already solved the problem of standardizing the reciprocating engine, but there are two opinions about the standardization of the hulls. Some shipbuilders contend strongly that the best and quickest method would be to allow individual yards to standardize their own type of ship. As a matter of fact, shipyards already have what may be called their standardized ship, with which their designers, foremen and workmen are perfectly familiar; and the argument is that, provided the requisite materials are forthcoming—a rather big provision—the yards would build more quickly when working in the accustomed groove. The opposing argument is based upon the fact that the materials cannot be produced fast enough when the orders received are for sections of varying sizes, and that rapid output is at the moment of supreme importance.

Our Merchant Marine

THE United States Shipping Board is calling upon all Americans to give their undivided support to the merchant marine. Chairman Edward N. Hurley recently wrote to the president of an association of manufacturers as follows:

"Your letter is one of many I have received from American business organizations pledging hearty support of the American merchant marine. I am glad to know that so fine a spirit of team work exists in your organization.

"You ask what your organization can do. The first thing is to become acquainted with our merchant marine as Americans. Quite a number of business men write that they do no foreign trade and think the American merchant marine does not affect them, or they see no way to back it up because their community is far from the ocean. There is only one legitimate excuse for not being interested in the American merchant marine—that is, if you are not an American.

"You ask what can be done by a live merchant marine committee in your organization. The first task is to pull your membership and your industry or community together behind our new ships and begin spreading information about them. The members should know something about what we are doing; how many ships we are building; how many ships are flying the American flag, and whether we will do foreign business or not.

"This is the biggest national improvement that we have ever tackled. Measured in money it represents fifteen times the investment in the Panama Canal, and measured in time we are doing the job about five times as fast. It was American understanding and enthusiasm, not selfish interest, that dug the big ditch from Colon to Panama. We must all get on the job as Americans now and put through the merchant marine, because, like the Panama Canal, it is the right thing to do for the United States and the world.

"The first great task is to organize on this issue of the merchant marine and create a healthy, unselfish national curiosity about it. I want you to realize that the American merchant marine is going to take you into a new era. When peace finally comes we must be prepared to put our American spirit and energy at the service of other nations. They will need our money and our tonnage, our ability and team work in developing their resources. It isn't what we are going to get out of it that counts so much as what we are going to put into it. Read the Webb Act, which authorizes combinations for foreign trade. This is an epoch-making law full of wonderful possibilities for team work.

"Study foreign countries. Every man in this country to-day should be reading about the peoples and resources, ideals and needs of Latin America, Australia, South Africa, Canada, Mexico, the Orient and Europe. It is time for every business man to become a specialist in the literature of some quarter of the globe. It is time for American youth to dream dreams of foreign countries and cultivate the natural love of the sea and travel possessed by every healthy boy. It is time to study language. Spanish-speaking peoples have a future that will soon surprise the world.

"The organizing of true Americanism behind the American merchant marine is one of the most important tasks of the United States Shipping Board. It would be of little use to build these ships if we could not line every American up behind them."

This is a call for action to every true American. Pass the word along.

LETTER TO THE EDITOR

Analysis of Shipyards Organization

I would like to take up the question of "Effective Arrangement of Departments in Shipyard Organization," described on page 165 of the November issue, by G. F. S. Mann, B. S., under headings as follows:

First—Organization which is wrong in theory and practice.

Second—Changes which are customarily found more satisfactory.

Third—General.

Fourth—Suggested chart embodying the above which would make an organization more effective.

GENERAL MANAGER

Technical Department	Supply Department	Industrial Relations Department	Ship Construction Department	Production Department	Financial Department
Naval Architect Manager	Manager of Supply Department	Manager	General Supt. Manager	Manager	Treasurer Manager
Hull Drafting Section Ordering Engine Drafting Section Ordering Inspection Section	Purchasing Section Expediting " Material " Steel Store General " Miscellaneous "	Employment Section Housing " Service " Social & Entertainment " Health & Sanitation " Office Management " Transportation " (of Men) Guards, Fire, etc. Training School Section	Hull Construction Section Loft Anglesmith & Furnace Punch Shop Fitters Riveters Erectors Welding Machine Section Machine Shop Outside Machinists Blacksmith Shop Pipe Shop & Fitters Sheet Metal & Copper Electricians Foundry Woodwork Section Pattern Shop Joiner " Riggers Painters Shipwrights Stage Builders Plant Section Superintendent Construction	Planning Section Dispatch " Progress "	Auditing Section Accounting " Cost Finding " Estimating " Time Keeping "

I assume a yard of 1,000 ship workers, exclusive of office force, to be one generally termed "small" now-a-days.

Under the first heading comes the question of responsibility of plate and angle storage. As a store's function, it should be treated as such and grouped with other stores, but as a distinct section of this division. The hull superintendent, primarily concerned in construction, should not be responsible for clerical work of stores' accounts.

The organization of pipe shop under the machinery superintendent and pipe fitters under the hull superintendent should both be responsible to the machinery superintendent. The organization of paint shop under the hull superintendent and painters under plant engineer should be changed to centralize responsibility of painting work.

The most important department in modern shipyards—the service or industrial relations department—is entitled to more consideration than the grouping "miscellaneous." In this division are the important functions of employment, watchmen and dispensary, but the more important ones in view of holding men employed, of housing, social entertainment, health and sanitation, transportation (as it affects facilities used by workmen), advertising, publicity, draft exemptions, absentee section, general office management.

Under this second heading comes the question of the grouping of naval architect and chief engineer. The older yards needed the naval architect as designer, etc., but with our ships already designed his late functions become of less importance, and the manager may now look to him for more responsibility in all matters of a technical nature, i. e., specifications, plans, requisitions for ship material, inspection (applying to accuracy with which plans are carried out).

The necessity of a department responsible to the manager, whose functions are to plan the work to be done at stated times by various departments and show progress on such plans is receiving so much attention in modern business that it cannot safely be omitted from the smallest organization which is concerned with contracts in which time is the essence.

A beneficial change could be made in the organization of the construction departments, so that one general superintendent is responsible to the manager for ship construction. Under this could be a superintendent of hull construction, superintendent of machinery and superintendent of woodwork. With this last the pattern, shipwrights, painters, joiner shops, etc., would be more effective than that shown.

Under this general superintendent would come the plant engineer and the maintenance of plant. Only in extensive and unusual building is the position of plant engineer of sufficient importance to require direct supervision of the manager.

Under the third heading, "General," I would say there were too many departments. Also there are departments under departments and divisions under departments, and a "general" manager with no manager. It would seem the best arrangement to arrive at as few departments as practicable and recognize a department manager. Under the department manager there should be sections with section chiefs, etc. There would then be more consistency regarding terms, and persons not familiar with the organization would benefit thereby.

A proper control of the organization by the management would be obtained by weekly or bi-weekly meetings of departmental heads restricted, as stated, to as few as practicable. The general policies of the company and of the effect on department work would be reviewed, and, with a follow-up on the work it had planned, assistance could be given any lagging department. In connection with this, a weekly meeting of section heads under each department manager, at which the general manager would attend in case of need, should give a very good control of the work in every department in the business.

It will be noted by the organization chart submitted that the departments are so grouped that the work done by each section has a very close relation to that of other sections in the same department. This gives an assurance of continuance of department work and policy with promotion of section heads.

New London, Conn. FREDERICK THORNE WARNER.

Shipbuilding in the United States in 1918

Three Million Tons of Merchant Ships Completed in First Eleven Months—Rate of Production Rapidly Increasing

SHIPBUILDERS in the United States are now turning out merchant vessels at the rate of over 4,000,000 deadweight tons a year. In addition to this, they are engaged on the most extensive programme of naval construction that has ever been undertaken by the Government. Details of the naval programme must obviously be withheld at the present time, but the main features of the merchant shipbuilding programme have been disclosed by the Shipping Board, and the following shows the progress that has been made in this work.

The output of merchant vessels from American shipyards for the first eleven months of 1918, including the output of the first week in December, amounts to 535 vessels of 3,022,606 deadweight tons. The total output from August, 1917, to December 1, 1918, has amounted to 3,054,460 deadweight tons, divided among the principal districts as shown in Table 1:

TABLE 1.—VESSELS DELIVERED TO THE SHIPPING BOARD FROM AUGUST, 1917, TO DECEMBER 1, 1918

District	Number of Vessels	Deadweight Tonnage
Pacific Coast	211	1,480,385
Atlantic Coast	120	848,790
Great Lakes	192	674,585
Gulf Coast	14	50,700
Total to December 1	537	3,054,460

By the end of 1918 about three and a quarter million deadweight tons of new ships will have been completed and delivered to the Shipping Board. The first million tons of completed ships were delivered in May, the second million in August, and the third million in the first week of December. The best pre-war production record, including only sea-going vessels of more than 1,500 deadweight tons, was in 1916, when 38 vessels of 285,555 tons were built and placed in commission. In the first week in December, therefore, when 138,700 tons were produced, American shipyards completed more than half of the total tonnage built in the record year of 1916, and the output in the first eleven months of 1918 has been more than ten times the tonnage produced by American yards in the best pre-war year.

Output from Individual Yards

The output of steel, wood and composite vessels from the principal shipyards for the first eleven months of 1918 is shown in Tables 2, 3 and 4, while Table 5 shows the monthly output (in gross tons) since January, 1918, as recorded by the Bureau of Navigation of the Department of Commerce.

Official Returns from the Bureau of Navigation

According to the official figures of the Bureau of Navigation, during the twelve months ended November 30, 1918, the ships built and officially numbered totaled 1,814 of 2,560,503 gross tons, of which 437 of 1,771,560 gross tons were sea-going steel steamers. Table 6 shows the

TABLE 2.—STEEL MERCHANT VESSELS DELIVERED TO THE UNITED STATES SHIPPING BOARD DURING THE FIRST ELEVEN MONTHS OF 1918

Shipyards	Number	Tonnage	Number of Vessels	Deadweight Tonnage
Bethlehem Shipbuilding Corporation, Ltd., South Bethlehem, Pa.				
Union Iron Works, San Francisco, Cal.	17	188,525		
Sparrows Point (Maryland) Plant	7	61,250		
Fore River Plant, Quincy, Mass.	6	58,300		
Harlan & Hollingsworth Plant, Wilmington, Del.	7	31,350		
Samuel L. Moore & Sons Corporation, Elizabethport, N. J.	2	7,000		
			39	346,425
American Shipbuilding Co., Cleveland, Ohio			87	305,450
Skinner & Eddy Corp., Seattle, Wash.			25	220,200
Northwest Steel Co., Portland, Ore.			14	123,200
New York Shipbuilding Corp., Camden, N. J.			15	118,300
Great Lakes Engineering Works, Detroit, Mich.			34	116,200
J. F. Duthie & Co., Seattle, Wash.			12	105,600
Seattle Construction & D. D. Co., Seattle, Wash.			12	93,000
Ames Shipbldg. & Dry Dock Co., Seattle, Wash.			10	88,400
Columbia River Shipbldg. Corp., Portland, Ore.			10	88,000
Moore Shipbuilding Co., Oakland, Cal.			9	84,600
Los Angeles Shipbuilding & Dry Dock Co., Los Angeles Harbor, Cal.			8	70,400
Pusey & Jones Co., Wilmington, Del.			10	61,000
Standard Shipbldg. Co., Shooters Island, N. Y.			7	51,100
Sun Shipbuilding Co., Chester Pa.			5	50,300
Baltimore D. D. & Shipbldg. Co., Baltimore, Md.			7	46,000
Manitowoc Shipbuilding Co., Manitowoc, Wis.			12	41,200
Newport News Shipbuilding & Dry Dock Co., Newport News, Va.			4	40,805
Toledo Shipbuilding Co., Toledo, Ohio			11	35,080
Chester Shipbuilding Co., Chester, Pa.			4	34,500
William Cramp & Sons Ship & Engine Building Co., Philadelphia, Pa.			6	33,797
McDougall-Duluth Co., Duluth, Minn.			9	28,500
Albina Eng. & Mach. Works, Inc., Portland, Ore.			7	25,500
Texas Shipbuilding Co., Bath, Me.			2	19,940
Federal Shipbuilding Co., Newark, N. J.			2	19,200
Long Beach Shipbuilding Co., Long Beach, Cal.			4	18,000
Western Pipe & Steel Co., San Francisco, Cal.			2	17,600
Globe Shipbuilding Co., Superior, Wis.			5	17,500
Saginaw Shipbuilding Co., Saginaw, Mich.			4	14,000
Hanlon D. D. & Shipbldg. Co., Oakland, Cal.			2	11,000
Staten Island Shipbldg. Co., Staten Island, N. Y.			3	10,500

TABLE 3.—WOOD VESSELS DELIVERED TO THE UNITED STATES SHIPPING BOARD DURING FIRST ELEVEN MONTHS OF 1918

Shipyards	Number of Vessels	Deadweight Tonnage
Grant Smith-Porter Ship Co., St. Johns, Ore., and Aberdeen, Wash.	20	70,000
Seaborn Shipyards Co., Tacoma, Wash.	7	24,500
Grays Harbor Motorship Corp., Grays Harbor, Wash.	6	24,000
Kruse & Banks Shipbldg. Co., North Bend, Ore.	5	17,500
The Foundation Co., Newark, N. J.	5	17,500
Traylor Shipbldg. Corp., Cornwell Heights, Pa.	4	14,000
Russell Shipbuilding Co., Portland, Me.	3	10,500
Ralph J. Chandler, Los Angeles, Cal.	2	7,000
Fulton Shipbuilding Co., Wilmington, Cal.	2	7,000
Coos Bay Shipbuilding Co., Marshfield, Ore.	2	7,000
Groton Iron Works, Noank, Conn.	2	7,000
Tampa Dock Co., Tampa, Fla.	2	7,000
J. M. Murdoch, Jacksonville, Fla.	2	7,000
Coast Shipbuilding Co., Portland, Ore.	2	7,000
Hammond Lumber Co., Humboldt Bay, Cal.	2	7,000
Meacham & Babcock Shipbldg. Co., Seattle, Wash.	2	7,000
Morey & Thomas, Jacksonville, Fla.	2	7,000
Nilson & Kelez Shipbldg. Corp., Seattle, Wash.	2	7,000
Wilson Shipbuilding Co., Astoria, Ore.	2	7,000
McEachern Ship Co., Astoria, Ore.	2	7,000
Dierks-Blodgett Shipbldg. Co., Pascagoula, Miss.	2	7,000
National Shipbuilding Co., Orange, Tex.	1	4,700
Peninsula Shipbuilding Co., Portland, Ore.	1	4,000
Babare Brothers, Tacoma, Wash.	1	3,500
John H. Fahey, Jacksonville, Fla.	1	3,500
Tacoma Shipbuilding Co., Tacoma, Wash.	1	3,500
Alabama Dry Dock & Shipbldg. Co., Mobile, Ala.	1	3,500
Lone Star Shipbuilding Co., Beaumont, Tex.	1	3,500
G. M. Standifer Construction Corp., Portland, Ore.	1	3,500
Jahncke Shipbuilding Co., Inc., Madisonville, La.	1	3,500
Hodge Shipbuilding Co., Moss Point, Miss.	1	3,500
Beaumont Shipbldg. & D. D. Co., Beaumont, Tex.	1	3,500
L. H. Shattuck, Inc., Portsmouth, N. H.	1	3,500
American Shipbuilding Co., Brunswick, Ga.	1	3,500
Wright Shipyards, Tacoma, Wash.	1	3,500
Lake & Ocean Navigation Co., Sturgeon Bay, Wis.	1	2,500

TABLE 4.—COMPOSITE SHIPS DELIVERED TO UNITED STATES SHIPPING BOARD DURING FIRST ELEVEN MONTHS OF 1918

Shipyards	Number of Vessels	Deadweight Tonnage
Supple & Ballin, Portland, Ore.	4	16,000
Merrill-Stevens Shipbldg. Corp., Jacksonville, Fla.	3	10,500
Mobile Shipbuilding Co., Mobile, Ala.	1	3,500

TABLE 5.—MONTHLY OUTPUT OF AMERICAN SHIPYARDS FOR FIRST ELEVEN MONTHS OF 1918

Months.	Seagoing.						Non-Seagoing.		Grand Total.	
	Steel.		Wood.		Total.					
	Number.	Gross.	Number.	Gross.	Number.	Gross.	Number.	Gross.	Number.	Gross.
January	12	53,748	6	6,468	18	60,216	39	4,579	57	64,795
February	17	94,242	14	17,874	31	112,116	53	5,485	84	117,601
March	29	115,040	12	20,776	41	135,816	97	11,329	138	147,145
April	31	130,637	15	21,017	46	151,654	119	11,396	165	163,050
May	*a*40	157,598	13	16,453	53	174,051	132	20,413	185	194,464
June	42	163,034	16	26,985	58	190,019	130	11,406	188	201,425
Tota	171	714,299	76	109,573	247	823,872	570	64,608	817	888,480
July	37	146,981	38	72,727	75	219,708	118	*b*10,223	193	229,931
August	49	191,102	39	91,997	88	283,099	89	12,750	177	295,249
September	46	177,765	54	123,668	100	301,433	70	7,037	170	308,470
October	57	228,203	53	117,165	110	345,368	91	12,164	201	357,532
November	60	227,293	55	121,746	115	349,039	56	*c*8,621	171	357,660

a Includes 1 cement vessel of 3,427 gross tons. *b* Includes 1 cement vessel of 325 gross tons. *c* Includes 1 cement vessel of 11 gross tons.

TABLE 6.—OUTPUT OF AMERICAN SHIPYARDS FOR TWELVE MONTHS' PERIODS ENDING AT THE CLOSE OF EACH MONTH IN 1918

Twelve Months Ending	Seagoing						Grand Total Including Non-Seagoing.	
	Steel.		Wood.		Total.			
	Number.	Gross.	Number.	Gross.	Number.	Gross.	Number.	Gross.
January	144	607,404	137	211,626	281	819,030	1,657	1,025,496
February	157	682,867	146	222,723	303	905,590	1,669	1,106,093
March	180	759,354	153	238,051	333	997,405	1,670	1,194,127
April	203	845,338	157	236,498	360	1,081,836	1,668	1,278,132
May	232	966,850	151	219,947	383	1,186,797	1,661	1,381,369
June	252	1,031,976	158	215,716	410	1,247,692	1,622	1,430,793
July	275	1,124,066	189	274,330	464	1,398,396	1,610	1,571,572
August	315	1,268,452	214	354,172	529	1,622,624	1.612	1,781,379
September	352	1,411,144	256	465,327	608	1,876,471	1,681	2,013,264
October	396	1,594,927	287	546,613	683	2,141,540	1,760	2,280,111
November	437	1,771,560	331	657,487	768	2,429,047	1,814	2,560,503

output for twelve-months' periods ending at the close of each month of 1918 and illustrates the growth of shipbuilding under the impetus of the war.

Shipping Board Programme

The complete programme of merchant ship construction, as authorized by the United States Shipping Board up to October 15, 1918, is summarized in Tables 7-10.

TABLE 7.—REQUISITIONED SHIPS

Type	Number of Ships	Tonnage
Cargo	311	1,978,362
Tankers	60	580,430
Refrigerators	10	72,900
Colliers	9	70,350
Transports	12	88,750
Total	402	2,790,792

TABLE 8.—CONTRACT SHIPS

Type	Number of Ships	Tonnage
Steel	1,604	10,513,905
Wood and composite	1,034	3,024,000
Concrete	42	298,500
Total	2,680	13,836,405
Foreign construction	34	285,850
Total	2,714	14,122,255

TABLE 9.—SUMMARY OF STEEL SHIPS CONTRACTED FOR

Type	Number of Ships	Tonnage
Cargo	1,296	8,877,605
Tankers	80	737,000
Transports	94	787,000
Hospital	2	20,000
Refrigerators	4	37,500
Tugs	112	......
Barges	16	54,800
Total	1,604	10,513,905

TABLE 10.—WOOD AND COMPOSITE SHIPS

Type	Number of Ships	Tonnage
Concrete	181	707,500
Hulls	519	1,841,000
Barges	140	359,500
Tugs	162	....
Composite	32	116,000
Total	1,034	3,024,000

Government Expenditures in Shipyards

Up to September 1, 1918, the Emergency Fleet Corporation had invested or contracted to invest in shipyard plants approximately $150,000,000. Of these investments, the largest were at the Hog Island plant, estimated cost complete, $63,000,000 (£13,000,000), and at the plants of the Submarine Boat Corporation, estimated cost, $17,000,000 (£3,500,000); of the Merchant Shipbuilding Corporation, estimated cost, $11,000,000 (£2,260,000); the New York Shipbuilding Corporation, estimated cost, $16,825,000 (£3,460,000), and the Carolina Shipbuilding Company, estimated cost, $3,000,000 (£615,000).

The Emergency Fleet Corporation has investment interests made or authorized in forty-one shipbuilding plants, the majority of these in connection with contract-built ships. The expenditure of approximately $10,500,000 (£2,150,000) for Scotch boiler plants and for steel fabricating plants has also been authorized.

Growth of the Merchant Marine

As all the ships turned out from American yards in 1918 are destined for operation under the American flag, the American merchant marine has during this period expanded more rapidly than that of any other nation in the world. At the time the United States entered the war the American merchant marine included approximately only 2,750,000 deadweight tons of sea-going vessels of over 1,500 deadweight tons. On September 1, 1918, however, there were under the control of the United States Shipping Board 2,185 sea-going vessels totaling 9,511,915 deadweight tons. Of these, 1,294, totaling 6,596,405 deadweight tons were under the American flag.

Of the total number of ships within the jurisdiction of the Shipping Board at this time, 449 were requisitioned American merchant ships, 100 were enemy vessels seized during the war, 256 were new vessels owned by the Ship-

ping Board, 31 were old Lake steamers transferred to the Shipping Board, 377 were American merchant ships not yet requisitioned, 81 were Dutch ships requisitioned by the United States Government, and 891 were foreign ships chartered either to the Shipping Board or to American citizens. While only a comparatively small part of this tonnage was provided by the Shipping Board, nevertheless at the rate at which vessels are now being built by American shipyards for the Government's programme it will not be long before something like 10,000,000 gross tons of American-built and American-owned vessels will be added to the merchant fleet.

Expansion of the Shipbuilding Industry

For the production of this tonnage the growth of the American shipbuilding industry has been phenomenal. When the present Shipping Board began its work in August, 1917, there were only 61 shipyards in the United States. Thirty-seven of these, with 162 ways, were equipped for building steel vessels, but about three-quarters of their capacity was taken up by the naval construction programme. In the 24 yards equipped for building wood vessels, there were only 73 shipways.

Contrasted with this condition of hardly more than a year ago, there are now 203 shipyards in the United States with a total of 1,020 shipways, or more than double the total of the shipways in all the rest of the world. The list comprises 77 steel, 117 wood, 2 composite and 7 concrete shipyards. The Clyde district in Scotland, famous for years as the greatest of all shipbuilding centers, is already surpassed by four shipbuilding districts in the United States. Two of these, the Delaware River and Newark Bay districts, are on the Atlantic coast, and the other two, the Oakland Harbor and the Puget Sound districts, are on the Pacific coast. One yard alone in the Delaware district—the Hog Island plant—is equipped to produce more tonnage annually than the output of all the shipyards of the United Kingdom in any pre-war year. The United States, therefore, has taken the lead as a shipbuilding nation. It now has more shipyards, more shipways, more ship workers, more ships under construction and is building more ships every month than any other country, not excepting the United Kingdom, which hitherto was the first shipbuilding power.

In accelerating the construction of ships, such progress has been made that, in spite of the addition of many new yards, the average time consumed from laying the keel to delivery of the ship was reduced from 235.45 days in January to 203.7 days in August. During the year ended August 31, 1918, 566 keels were laid, 358 ships launched, 287 ships of 1,800,000 deadweight tons completed and placed in service, and 9,113,880 deadweight tons of ships have been contracted for.

Steel Ship Production

On September 1, 1917, there were 46 steel shipyards actually building ships for the Emergency Fleet Corporation, and there were 125 ships on the ways of a total deadweight tonnage of 881,072, and 27 ships in the water with a tonnage of 192,790, making a total of 152 ships and 1,073,862 deadweight tons under construction.

On November 1, 1918, there were 76 shipyards in which keels for steel vessels had been laid, and there were 374 vessels of 2,575,004 deadweight tons on the ways and 119 vessels of 798,622 deadweight tons in the water, making a total of 493 vessels and 3,374,616 deadweight tons actually under construction. In other words, there has been an increase of 30 shipyards engaged in building steel ships, and the amount of ship construction being carried on has increased by about 1,850,107 deadweight tons.

Shipyards on the Great Lakes have sent to the Atlantic since the beginning of the war a fleet of cargo vessels comprising 181 steel vessels aggregating 611,935 deadweight tons. The significance of this total will be better understood when it is stated that this exceeds by far the entire output of all the shipyards in the United States for any one of the four pre-war years. In addition to the 181 vessels sent to the seaboard since August, 1917, other vessel construction has been carried out on the Lakes.

Shipbuilding on the Great Lakes

It was a Great Lakes shipyard that turned over the first vessel to the United States Shipping Board. This was a 2,930-ton cargo steamship built by the Toledo Shipbuilding Company. Following this, the first substantial contribution to the transatlantic tonnage from the Lakes was a fleet of 21 steamships with a total deadweight tonnage of 77,400. These vessels ranged from 4,000 to 5,000 deadweight tons capacity, and some of them had to be cut in two to get them through the locks of the Welland Canal to the St. Lawrence River. These were among the first vessels commandeered by the United States Shipping Board, and 19 of them are still plying the seas. They were soon followed by the newly constructed vessels, which, up to November 1, numbered 160 of 534,535 deadweight tons.

The fleet of new steel cargo carriers from the Lakes is made up principally of single-deck vessels about 250 feet long, 40 feet beam, with a minimum draft of about 8 feet, commonly known as the *Frederikstad* type of freighters.

To a Great Lakes shipyard belong the world's record for the rapid construction of a steel cargo steamship. This record was won at the Great Lakes Engineering Works by completing the 3,500-ton cargo steamer *Crawl Keys* 34 days from the laying of the keel. The vessel was launched 17 days after the keel was laid. During the 12 months ended December 1, 1918, the Great Lakes Engineering Works built and delivered to the Shipping Board 34 steel vessels aggregating 122,000 deadweight tons. This output represents the delivery of a completed ship every nine working days of the year.

Shipbuilders on the Great Lakes have been successful in producing a ship of about 4,200 tons deadweight which can be passed through the Welland Canal. Designs were prepared for a vessel of about 6,500 tons deadweight which could be built on the Great Lakes in two sections, to be joined in the St. Lawrence River without the necessity of dry docking by the use of cofferdams. After careful consideration, this design was abandoned for the 4,200-ton size with a view to speeding up production, but, as a sufficient number of ships of the smaller size have now been provided, the future construction of the 6,500-ton vessel on the Lakes is being considered.

Shipyards building steel vessels for the Emergency Fleet Corporation have been asked to assume responsibility for arranging directly with the mills for the delivery of steel, in a general order which was issued under date of December 9, by the vice-president and general manager. This new policy is due to the fact that the supply of steel now promises to be ample and that the Steel Division of the War Industries Board has ceased its activities.

The order will not be put into full effect until February, 1919, because allotments of steel for delivery during January already have been completed. It will be necessary for deliveries of steel thereafter to be made by each shipyard directly with the mills. The Corporation reserves the right to instruct mills to suspend shipments if it is judged that the condition of the steel supply at any shipyard or fabricating plant is, or threatens to become, excessive.

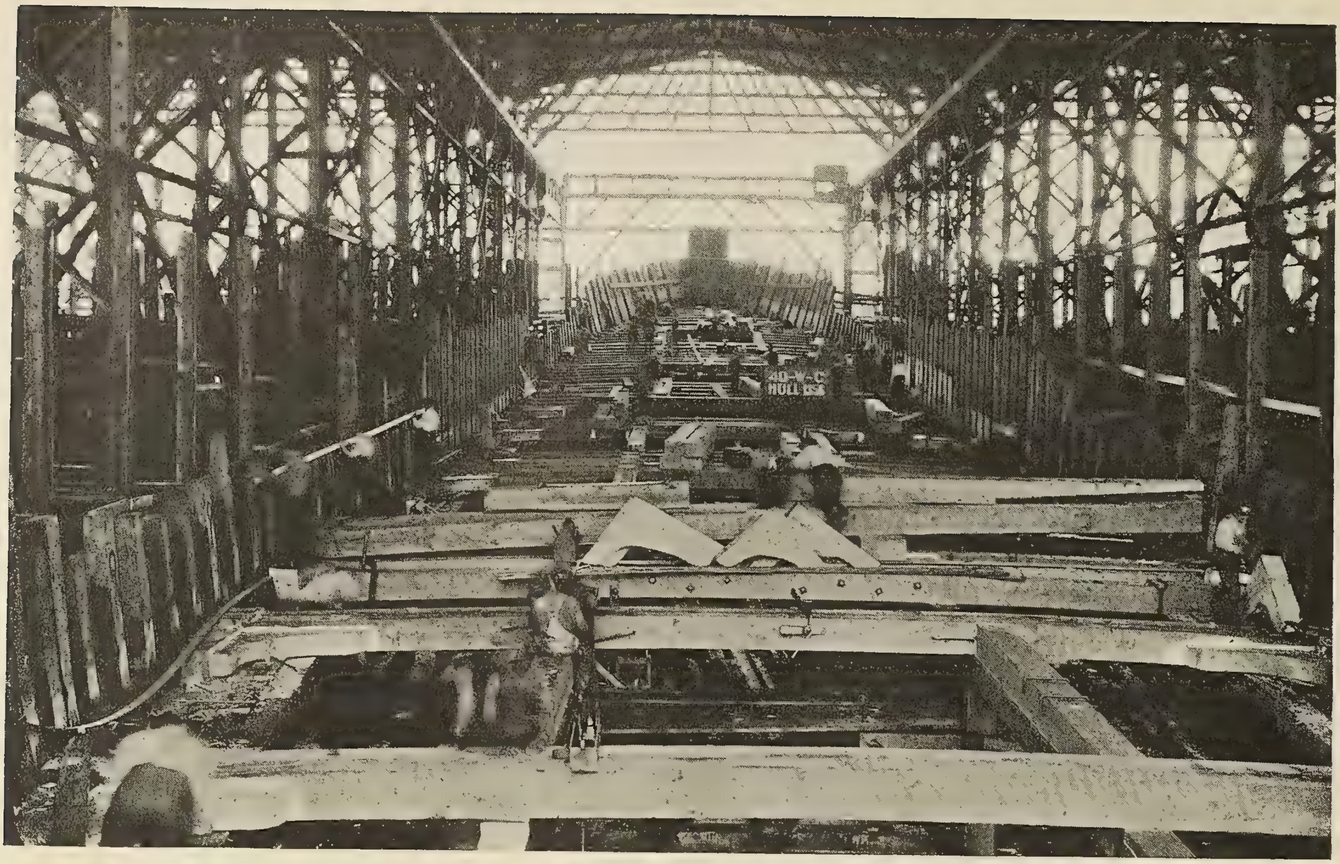


Fig. 1.—Immense Sheds Protect Men in Winter. Temperatures Are Such That Sides Are Not Required

Building Wooden Vessels on the Pacific

Record of Accomplishment—Hough and Ferris Types Give Way to 5,000-Ton Vessel—Wood Vessels Coming Into Their Own

THE history of the revival of wood ship assembling in Oregon and in the Northwest is fraught with interest from the very inception of the movement. Under the impetus resulting from the activities of the Emergency Fleet Corporation, this district has stood out as the leader in wooden shipbuilding in the United States. Those in the section claim the greatest number of hulls afloat and the delivery of the first completed ship. The location was, of course, a decided advantage. The huge fir trees adjacent to the Columbia River are felled, trimmed and rafted upon the river for towing to the mills. In fact, each shipbuilding locality has mills nearby; in a few cases shipyards are actually on the property adjoining the mills.

Nevertheless, the speed with which American shipbuilders have responded to the demand for Yankee tonnage—the Northwest, especially, in the construction of wooden steamers to augment the gigantic fleet which the Government has been assembling through the Emergency Fleet Corporation—has helped to pile up the clouds of defeat which rolled down upon the German horizon.

Oregon Section Pushes Construction

As to the wood plants of the Oregon section—officially designated as District Number 11—they are in their full stride. On February 17, 1918, the first hull, a Hough ship, went overboard; there were sixty-five wooden ships in the water by November 1. Of that number, thirty-three were officially delivered as finished vessels up to November 8. The schedule calls for sixty-three in all to be in commission by December 31, 1918. When October closed seventy-one hulls were yet to be completed.

Fifteen Plants Building Ships

In all, there are fifteen wood ship plants; twelve have been working upon Emergency Fleet Corporation contracts for some time, another is preparing for Government ships after having turned out tonnage on private account, while one has floated eighteen of twenty steam auxiliary schooners for the French Government, and the last has eleven private ships to its credit, not having taken on Federal business yet. And all of the hull work, with a large percentage of the fitting out details, have been taken care of with a total of 15,000 men.

That roughly summarizes the status of wood ship construction in the Oregon district to-day. But it does not tell the story, other than from the standpoint of results. The historical background which made this production possible is another tale.

It was Oregon that led the way in the introduction of large auxiliary schooners of the wood type. The *City of Portland*, a five-master, fitted with semi-Diesel engines to drive twin propellers, was the vanguard. She has circled the globe since her completion two years ago. The precipitation of the European war almost immediately created a call for more tonnage on the Pacific side. It

was first felt in the loss of vessels owned by the Allies from the trans-Pacific trade, liners and tramps being taken for military necessities. Later American owners began to find their ships sought by agents of the countries at war. In a comparatively short time even steam schooners, the wood carriers so familiar on the Coast, were being negotiated for. The old reliable "fore and aft" schooners, which some authorities had held a few years ago would soon be numbered with "bone yard" relics because of the inroads of steam tonnage, were suddenly most popular. With lumber orders piled high and tonnage limited, the natural result was for vessel owners to turn to a type of ship that could be built at home, of native material and along lines regarded best fitted for the Pacific service.

The St. Helens Shipbuilding Company first built the auxiliary schooner *City of Portland*. Others of the same design were soon on the stocks. Within a year other plants were projected and they were in position to give the American government assistance when, following the declaration of war against Germany, the Emergency Fleet Corporation was formed and included wood vessels in its program. The entrance of the Government into the market had a most stimulating effect upon the building of new plants. Work was carried along with phenomenal speed.

Fig. 2.—They Calk Decks With This Machine, the Design of an Oregonian. Two Men Do the Work of Eight Hand Calkers

Nine Shipyards Within Street-Car Radius

To-day there are nine wood plants in the Portland zone —that is, within street car radius—and another at St. Helens, 28 miles below Portland. Columbia City, less than two miles from St. Helens, boasts a yard; three more are located at Astoria, just inside the entrance to the Columbia River, and one at Tillamook, on the Oregon coast a short reach from the Columbia. Two more yards are maintained on Coos Bay, Oregon, but, because of geographical location, are included by the Government in the California district—a total of seventeen yards.

The Hough and Ferris designs were first laid down in the yards. Both are of the 3,500-ton type, deadweight. The Hough ship is 288.6 feet overall, 274 feet between perpendiculars, has a beam of 45 feet and molded depth of 28 feet. The Ferris ship is 281.6 feet overall, 268 feet between perpendiculars, with a beam of 46 feet and molded depth of 26 feet. Both are being given a total of 1,400 horsepower, the Hough ship with twin engines and the

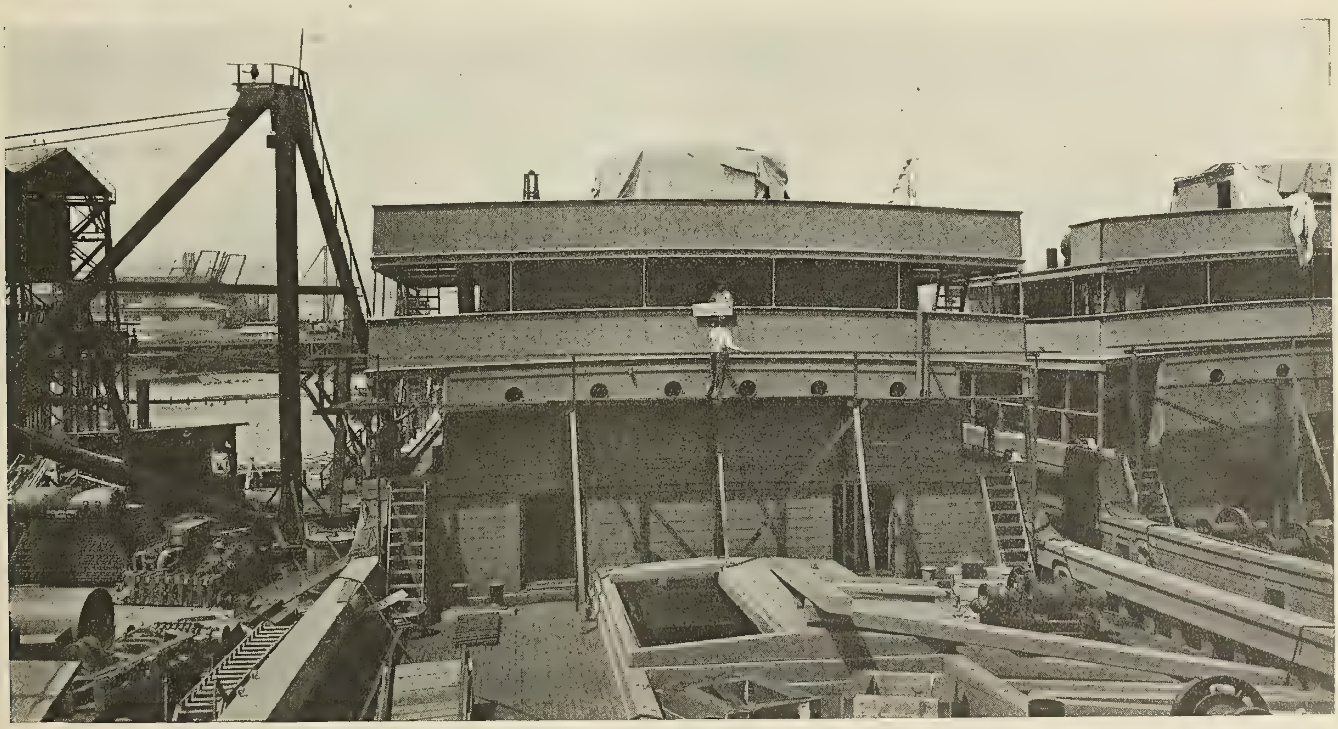


Fig. 3.—Hull 59, Forward, Looking Aft. Here She Is in the Hands of Machinists and Joiners

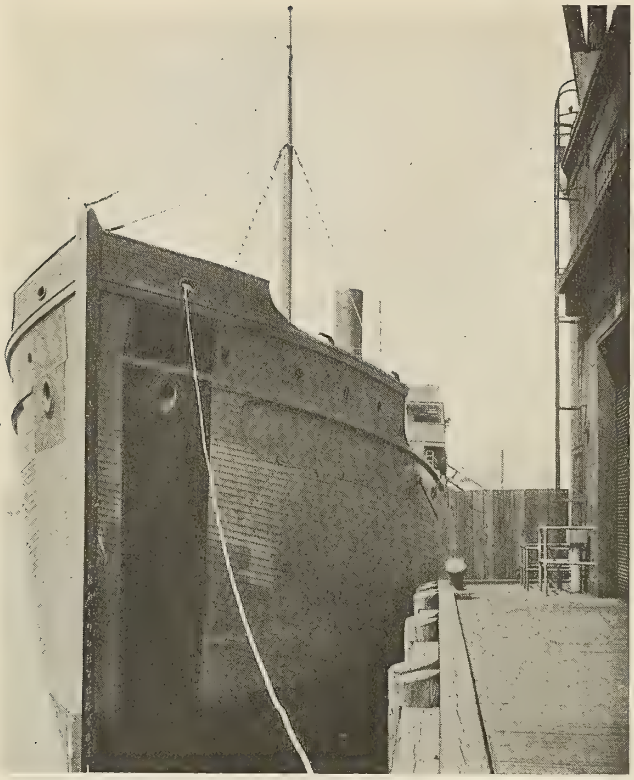


Fig. 4.—Bow View of Hull No. 229. Only a Few Days Before She Moves Down the Harbor to Do Her Share in War Transportation

Ferris with a single main engine. Not since the yards were first started, however, has the Government repeated orders for the Hough ship, apparently having preference for other types.

The development of local designs followed. Fred A. Ballin, of the Supple-Ballin Shipbuilding Corporation, introduced a composite ship with steel topsides; these ships have a deadweight capacity of 4,500 tons. The vessels are 308 feet overall, 286 feet between perpendiculars, with a beam of 43 feet and molded depth of 36 feet, having 1,600 horsepower. The Peninsula Shipbuilding Company is the parent of what is known as the "Peninsula" ship, a distinctive all-wood type with a deadweight of 4,000 tons. This ship calls for a length overall of 282.8 feet, and 267.8 feet between perpendiculars. The beam is 48.8 feet and the molded depth 27 feet. Turbine engines of 1,500 horsepower are installed. This is the only wood ship design, so far as is known, in which turbine engines are used. Trials of the first vessels have proved most satisfactory.

Last of the special plans is a 5,000-ton all-wood steamer, the result of experiences of government officials and the builders, who have foreseen the demand for a larger carrier. The plans and specifications have been approved by Lloyds and the American Bureau of Shipping, and construction has been authorized by Charles Piez, vice-president and general manager of the Emergency Fleet Corporation. The ship will have a length of 344 feet 5 inches overall and 315 feet between perpendiculars, with a beam, molded, of 48 feet, and depth, molded, of 34 feet 6 inches. The vessel has a full shelter deck and two 'tween decks. The material for these ships will be of unusual length, and in some features, such as keel, keelson, stem and stern construction, will call for pieces of large dimensions. For the present, these vessels will be engined with the motive power designed for the 3,500-ton vessels, but ultimately more power is to be provided. These 5,000-ton ships can be laid down at the yards without additional or different equipment and without extension of the building ways.

Wood Ships Stand Up Under Criticism

Wooden ships, not as to specific designs, but in general, have come in for a share of the general criticism of shipbuilding, which is new to this country in its present large proportions, but, through it all, are "standing up." The satisfactory service of many wooden vessels is sufficient refutation. For example, *La Merced,* an auxiliary schooner built on Puget Sound, has made two voyages with wheat, discharging the first cargo at San Francisco in February and the second in August; both cargoes were in good condition. Another steamer, the *Calusa,* of the Hough type, reached New York in September with her cargo in such fine condition that the Control Committee recommended that stores for the army and navy forces be carried from the Atlantic to the Pacific on those vessels. The *Blandon,* also a Hough ship, has been in service four months between Portland and San Francisco, replacing the steamer *Beaver,* a steel combined passenger and freight vessel taken for war purposes. While the company would not have selected an exclusive freight vessel for the run in normal times, she has proven so satisfactory to her master and chief engineer that they have protested against having the vessel sent into the deep-water trade and receiving one of another design in lieu of it. Steamers of the types being built here have developed speeds up to 13.6 knots—that is with coal, for the Government has not permitted fuel oil to be used in either steel or wood ships of the Emergency Fleet coterie since the decision was made to husband all resources for the navy abroad.

These ships were selected to meet just what the title of the big shipbuilding body indicates—an emergency. If details of construction, machinery and other features are not of the best, they will be changed just as army and navy

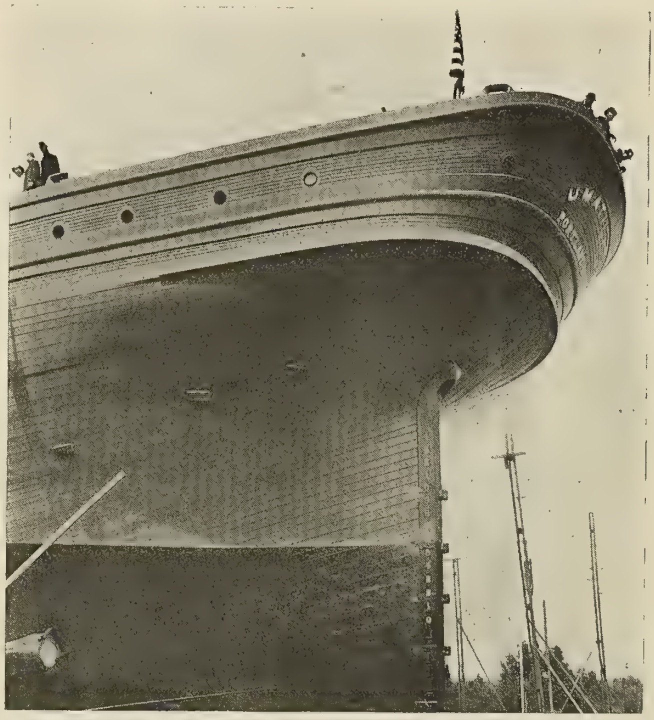


Fig. 5.—Lines of a Ferris Ship Aft, Showing What Can Be Done in Shaping Fir Timber

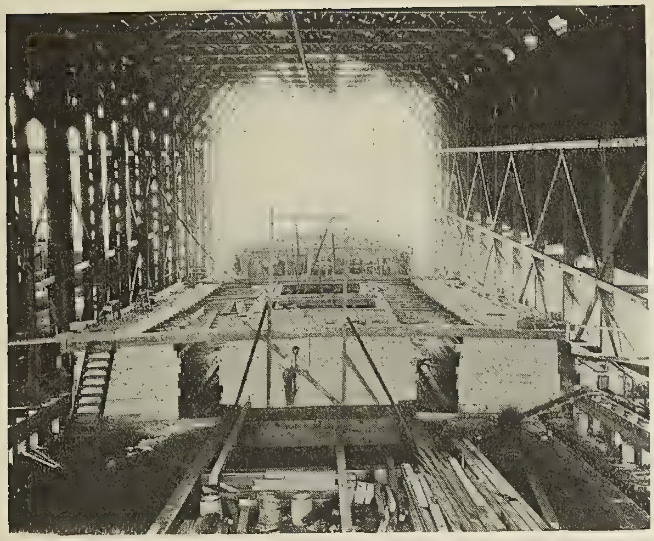


Fig. 6.—With Decks Well Along, the Hull Begins to Look Shipshape

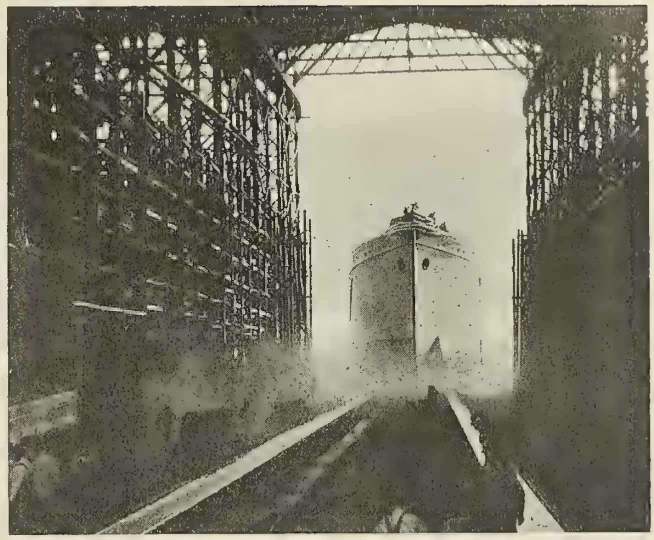


Fig. 7.—Launching of S. S. *Nepolela* to Answer the Hun Challenge

equipment is improved on thorough experience. Much the same arguments that have gone the rounds regarding the wood vessels, might be as aptly applied to some of the steel carriers. Accidents resulting from green crews, however, the "salting" of boilers on the Pacific by the oversight of an engineer whose previous experience was on the Great Lakes, the damaging of winches by inexperienced men, or the permitting of boilers to "go dry"—these can hardly be classed as imperfections in the design of the naval architect.

Wood Ship Here to Stay

Oregon builders do not regard the wood ship as an emergency vessel, however. They were being turned out in this region before the Civil War. In fact, it is on record that seventy-seven years ago the schooner *Star of Oregon* was built by Joseph Gale just across the river from where the Peninsula Shipbuilding Company's present plant stands. Her keel was hewn from a fir timber and her planking was whipsawed. She was in the San Francisco-Hawaiian Island trade for a long period. It was forty-four years ago, on Coos Bay, Oregon, that the full-rigged ship *Western Shore* was built by A. M. Simpson, pioneer shipbuilder and lumberman. The *Western Shore* loaded wheat on her maiden voyage, taking the cargo aboard at San Francisco and delivering it at Liverpool; she was loaded back from there with general cargo. The round voyage was done in 205 days, a feat no metal ship has yet equaled.

Recent tabulations show that Pacific Coast owners control 350 wood steam vessels operating in the Coast and offshore trade. In the fleet 68 are more than 20 years old, 53 are from 20 to 25 years old, 78 from 25 to 30 years, 46 from 30 to 35 years, 42 from 35 to 40 years, 44 from 40 to 45 years, 10 from 45 to 50 years, 5 from 50 to 55 years, and 3 yet running are 61, 65 and 68 years old—a fine record.

Durability Proved

These figures seem to show beyond doubt that there is no question as to durability of the wood ship; but, as with metal ships, they must be given reasonable care. Calking and painting wood ships in the way of maintenance is no more expensive than chipping and painting steel ships to prevent rust from eating the plates.

Stimulated to increased production by the war necessity, which has also served to bring the tried utility of the wooden ship again into prominence, the Oregon shipbuilders feel that the new impetus will continue in momentum during the reconstruction days to come, and provide tonnage to develop Pacific trading facilities to their fullest capacity in the American merchant marine.

Fig. 8.—Sample of Douglas Fir Timber Used in Construction of Wooden Vessel in Oregon

Fig. 1.—General View of Outfitting Dock, Looking West

Shipbuilding at the Pensacola Yards

Well-Constructed Plant for 9,000-Ton Fabricated Steel Ship—Use of Permanent Scaffolding—Powerful Plate Bending Machine

BY JOHN M. SWEENEY*

THE question of establishing at Pensacola berths and equipment for assembling ships at tide water of material fabricated at bridge and structural shops situated near a base of material supply and already in operation, with facilities and tools required for such fabrication, was advised by the writer and considered favorably long in advance of the organization of the Emergency Fleet Corporation. At this time there had just been completed at a structural iron works plant in the Middle West, and under the writer's direction, the fabrication complete of fourteen hulls of light construction. Some suggestions from the experience gained in this fabrication were made to E. Platt Stratton, who incorporated them as a part of his essay on standardized ships prepared under direction of Secretary Redfield, Secretary of Commerce. This paper was used before the Committee of Merchant Marine of the House of Representatives, and later published in pamphlet form and circulated by the Bureau of Commerce.

The first four of these light vessels were set up in 1913 and were of the earliest so fabricated. The American Bridge Company, at their Ambridge plant on the Ohio River, had for some time been building water craft of steel, but confining their work to square ends, declining to undertake any modeled work requiring beveling of parts. They also erected work at their plant, and so in their operation largely adopted the customs of yards where the fabrication is done practically at ship side. In view of the many claims made as to the origin of so-called "fabricated" ships, it may some day be of interest to note these early operations in this field. At the time the vessels mentioned here were undertaken in the industrial shop, the present general manager of the Pensacola Shipbuilding Company was in charge of operation at that plant. Following his later connection with the parent organization of the Pensacola Shipbuilding Company, the project of taking up the fabricating of ocean-going ships inland, and their erection at Pensacola as a desirable point was fairly well canvassed and naturally was expanded into an accomplishment through the demand of the Emergency Fleet Corporation for ships.

The shores of Pensacola Bay offer many excellent spots for shipyard locations, merging as they do into the banks of several bayous, which are really enlargements of the fresh water streams from the water sheds of western Florida and Southern Alabama. The northeast bank of one of these, Bayou Chico, or Little Bayou, was selected for the yard site. A triangular piece of ground of approximately 120 acres, with about one mile of waterfront and entire railroad boundary on the opposite side, and all within the corporate limits of Pensacola, was chosen as best fitted for the general plan of a yard which was to be provided with a continuous-line erecting berth and arranged for side-launching. The water area of Bayou Chico is about 150 acres, and at the present time the erecting berth is some 2,800 feet in length, on which are

* Vice-president and consulting engineer, Pensacola Shipbuilding Company.

Fig. 2.—Bottom Plating and Vertical Keelson of Ship Number 966, Looking North

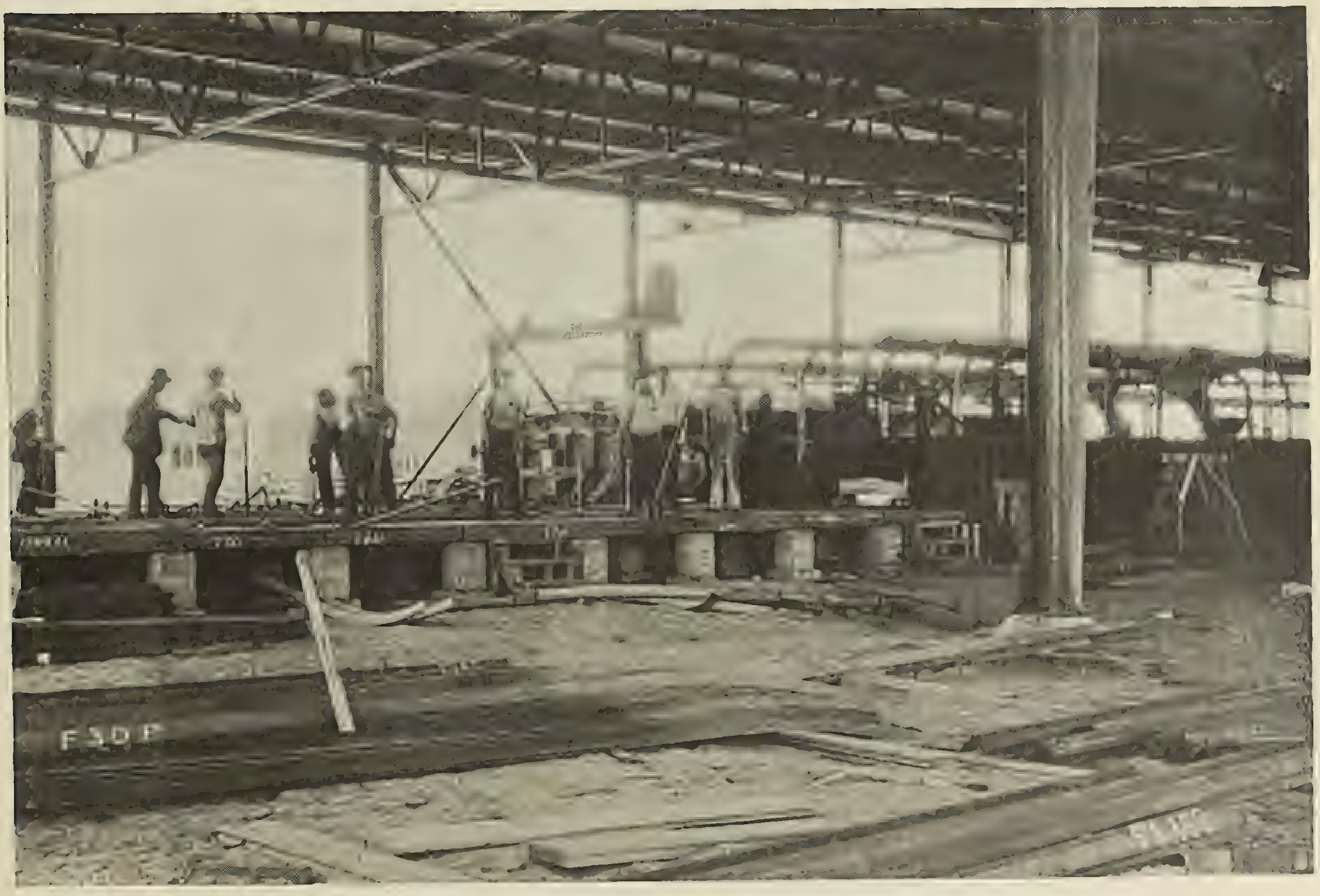


Fig. 3.—Fabricating Shop and Bending Floor, Looking Southwest

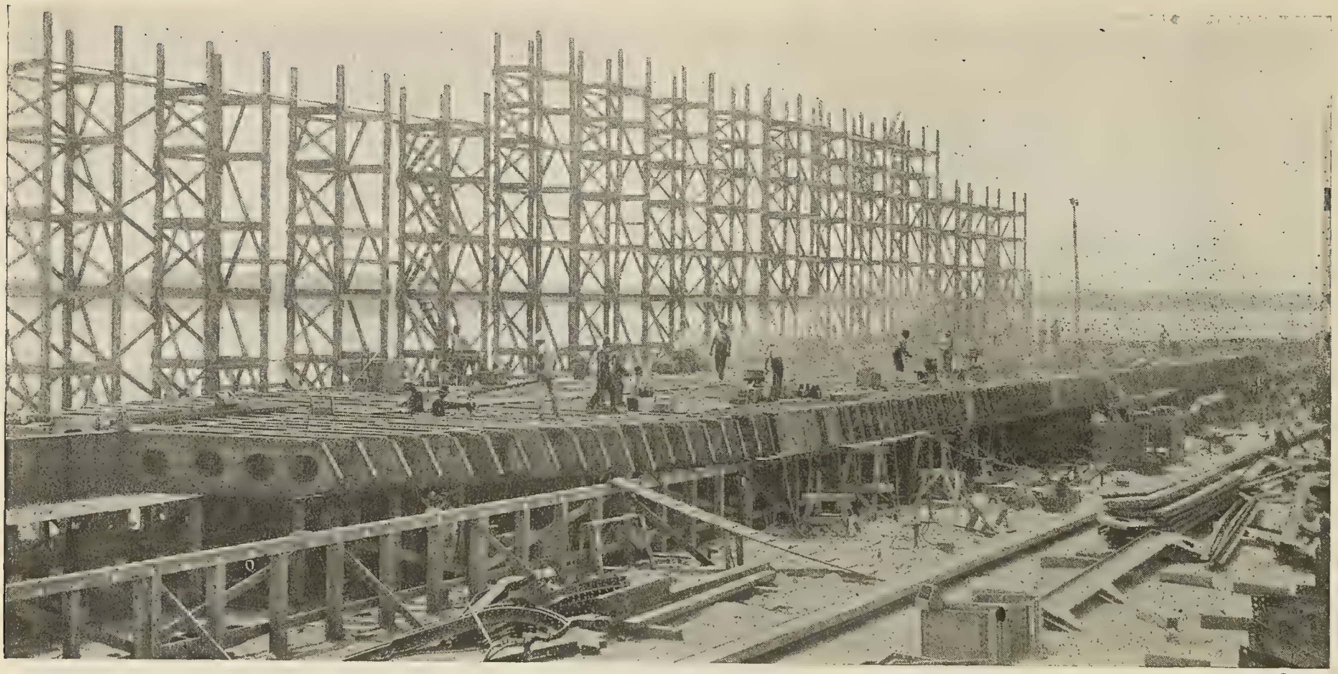


Fig. 4.—Hull Number 965 Showing Arrangement of Staging

in frame, in consecutive lengthwise position, five 9,000-ton steel ships. Beyond this line is a dock line of 1,000 feet for outfitting. On the land side of the berths, gantry tracks extend the entire length, where are traveling at present one gantry for each ship, but, as will be readily seen, with the ability to concentrate any number or all of the gantries at any one objective. On the land side of the gantry tracks there is for each ship a complete binnage for storage of all fabricated material for that ship, ready for transfer by the gantries to position on the blocks. These bins are supplied over a thorough system of ladder trackage connecting all of the yard berths, docks and buildings, and to the main line of the Georgia, Florida & Alabama Railroad.

The normal tide variation is 1.1 feet, one tide in each 24 hours. The general elevation of shipside bins is plus nine, and of fabricating shops plus fifteen.

The first foundation, that of the mold loft, was placed February 24. Operation commenced on the bending and fabricating shop, April 14. Keel blocks were in position ready for laying of the first keel on May 1. Two keels were laid June 21. The entire tract of ground is a strong white sand formation and provides choice conditions for all foundations for blocks and machinery. The berths are continuously piled their entire length in bents on 8-foot centers, the waterfront on 30-inch centers bulkheaded, and sand filled solid behind the bulkheading. The bulkheading is 3-inch yellow pine sheet piling, creosoted to 14 pounds per cubic foot. This method of berth construction has the advantage of providing for any length of ship without change or complication.

Beyond the building berth the dock line continues for 1,000 feet, providing space for fitting out berths, under heavy cranes, for placing boilers and machinery. The continuous building berth plan provides for side-launching only. This method is the one almost universally employed on the Great Lakes and it is the one preferred and favored by all engineers who have had experience with both end and side launching. They consider that it offers less chance of accident, creates less harmful strains and necessitates less cost for preparation.

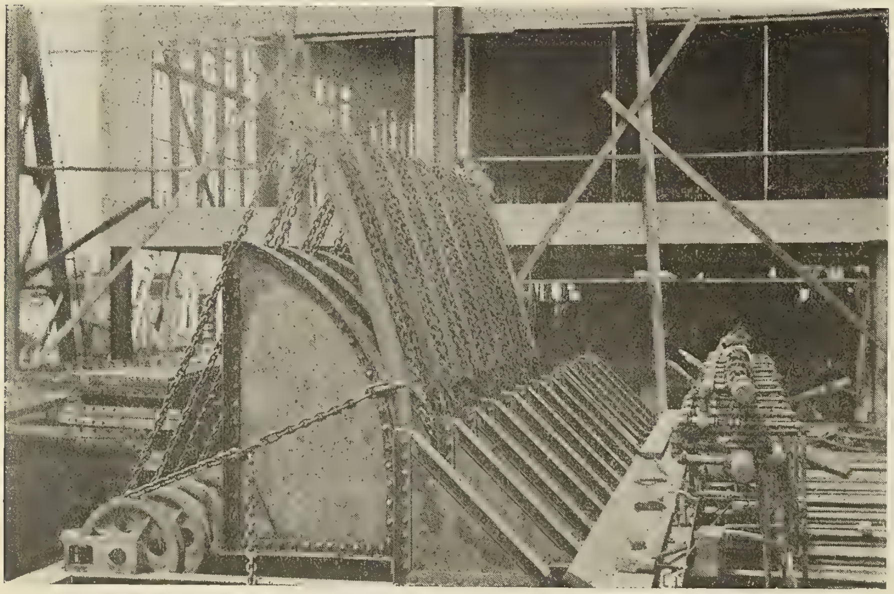


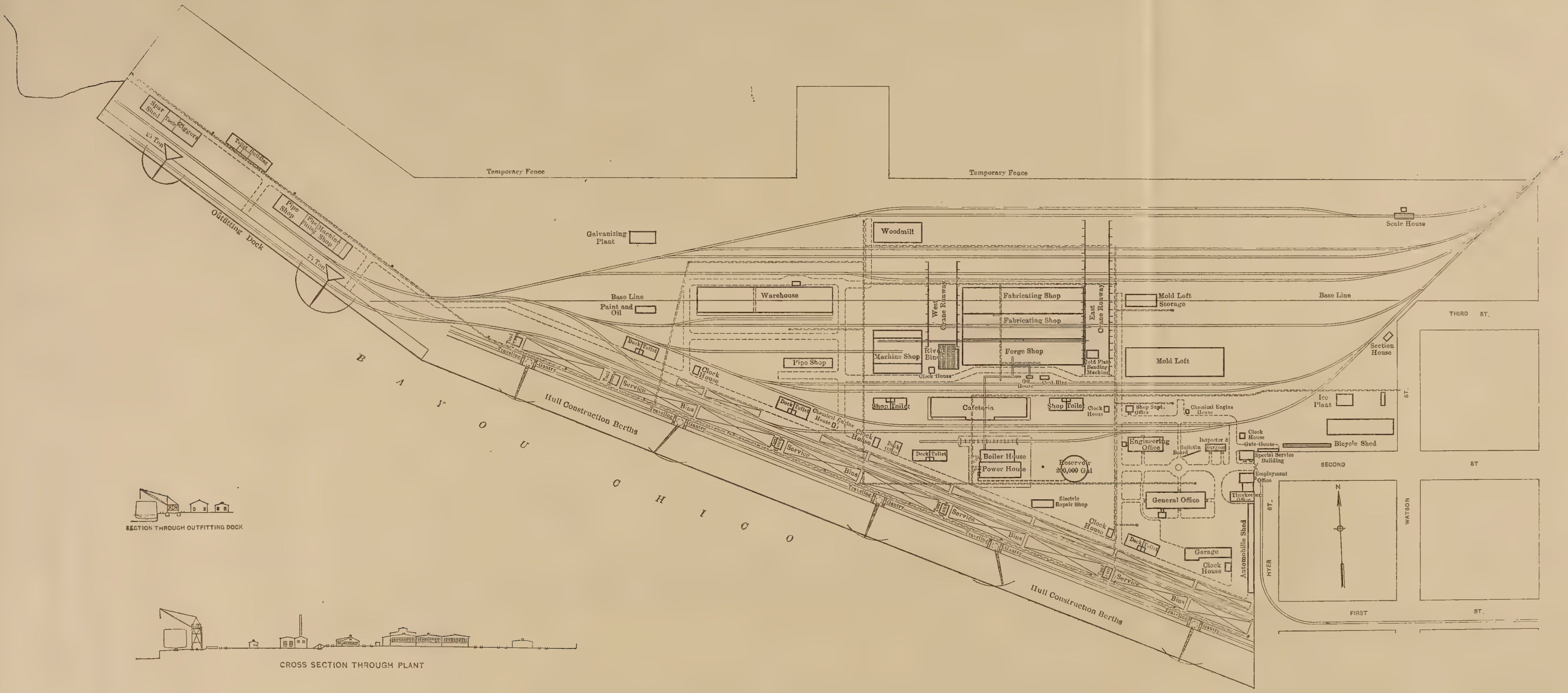
Fig. 5.—Plate Bending Machine Showing Plate Ready to Be Formed

One new yard on the Delaware River has been constructed for side launching and has already had several successful launchings. The first impression of the layman, and indeed often of engineers, is against the advisability of side-launching because of an impression that the ship is dropped on the water. This, however, is not the effect obtained. It may be more aptly likened to the skipping of a stone so thrown on the surface. Many ships approaching 600 feet in length are constantly launched by this method at the yards on our Great Lakes, and, so far as the record shows, without failure or injury.

Referring to the general layout of

GENERAL PLAN OF PENSACOLA SHIPBUILDING PLANT

Building Ways, Served by Traveling Gantry Cranes, Arranged for Side Launching of Vessels



Showing Location of Railroad Tracks in Relation to Shops, Hull Construction Berths and Outfitting Dock

the Pensacola Shipbuilding plant, in the track layout and location of buildings one of the first considerations was to plan that the flow of material should be as continuous in one direction as possible. Some incentive to this arrangement was found in a realization of the fact that materials arriving from the Chicago, Pittsburgh or Alabama districts were started from some 600 to 900 feet elevation above sea level and rolled down hill to the Pensacola yard. The most natural thing was to keep them on a down hill pull through the shops and yards to the erection blocks.

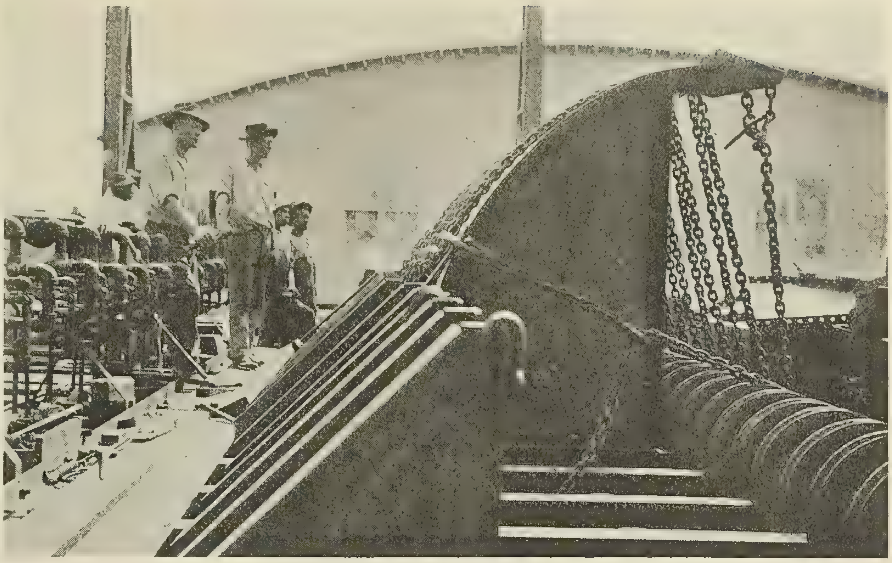


Fig. 6.—Plate Bending Machine Showing Plate Formed

Another actuating factor was the conviction that plenty of trackage and yard room formed a sort of "safety first" towards efficient and low cost ship construction. How well this has been met will be appreciated by every engineer who studies these conditions. The relief from the usual congested and poorly arranged shipyard was patent at every turn. Of course, most of our shipyards have expanded from smaller units, and therefore it has been impossible to avoid objectionable duplication of movement in handling. However, no yard recently built from a virgin location can more favorably compare in percentage of superior attributes than the yard in question. It merits the expressed opinion of an experienced engineer, who, on leaving the plant recently, said: "This is not only the best arranged and best balanced plant, but also it is the most picturesque of any I have seen or known of."

Mention of a few details of this construction will demonstrate the care with which it has been planned. The ladder track connections enable the placing of cars of material in position for unloading in the bins, warehouse, under crane runway, or in any shop or building with a minimum of interference with car movements within the yard. About six miles of trackage is laid within the yard limits, and in the history of the operation of this plant (so far) car demurrage cost is unknown.

The method of scaffolding construction is of a form more permanent than the usual single-bent plan. Here scaffold towers 6 feet by 8 feet and various suitable heights are used. Each tower is self-contained and anchored at the foot. They are placed generally with ten feet of space between them. The stage plank may be easily slipped through, leaving a clear space between the towers. This method avoids the necessity of hoisting material over the top of the staging. When launching, towers are easily lifted away, rested on end and quickly replaced for the next ship.

The gatehouses for employment and photographic headquarters, police department, hospital and inspectors' offices, garage, main administration office, engineering office and clock houses are of usual scope and plan, but are all of single-story construction.

The mold loft is a ground floor building 75 feet in width, clear span. The truss construction, of wood, is that known as lattice and requires no vertical bolting. This truss has been very satisfactory. Its general appearance is seen in the interior view of the loft. The same truss construction is used in the wood mill and cafeteria buildings. The location of the mold loft enables the ready reach of plates and shapes in stock under the receiving overhead crane runway or yard. Under this crane is located a plate-bending machine for cold plates, which is doing very satisfactory work. It was especially designed and developed from a crude machine put in use at the

Fig. 7.—Interior of Mold Loft, Looking East

fabricating plant and on the marine work before described.

The forge and fabricating shops, each 65 feet wide by 300 feet long, are adjoining. The forge shop contains, in order of progress of the material in fabrication, bending floors and furnaces, rivet machines and furnaces, steam and power hammers, furnaces and small fires, bolt header and bolt-threading machinery.

The fabricating shop is well supplied with the usual fabricating tools, riveters and furnaces. Oil fuel is used for furnace heating and is stored in appropriate tankage under ground and its distribution automatically controlled.

The machine shop is provided with new and modern tools, especially for heavy work. They consist of lathes, planers, slotter, large floor boring machine, radial drill, and also a complete small tool equipment. Electric power

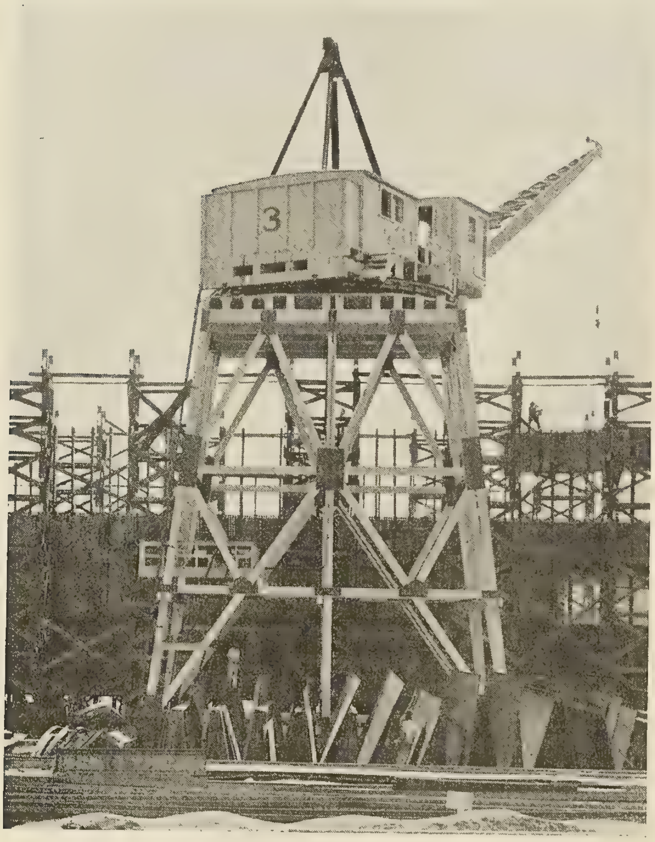


Fig. 8.—Broadside View of Hull Number 966

distribution is used throughout. The power plant, of 1,800 horsepower normal, has three watertube coal-burning boilers, direct current and alternating current generators, and modern air compressors of 5,000 cubic feet of air capacity at 100 pounds pressure. The air distributing pipe lines throughout the building berths and for all air power operations are extra large and provided with sump tanks and blow off over the entire system.

An eight-ton refrigerating plant is installed, and complete telephone intercommunication to departments and erection berths is in full operation. This plant promises to be in the "survival of the fittest" class for competitive construction of ships after the war. The conditions are ideal for ship construction, and not only provide advantages equal to those of southern California but also are much superior in the item of available labor and closer connections with the market for supply of all required materials.

Pensacola, with its favored water terminals, superior anchorages and abundant supply of low cost bituminous coal, must be a prominent factor in the marine expansion which the United States is now entering upon.

Geared Drive

BY N. W. AKIMOFF*

To an impartial observer, one of the most puzzling things about the installation of reduction gears on board ship is the attitude of the engineer who is investigating, designing or installing the gear. During the past twenty years all efforts have been directed toward the purely kinematical side of the problem; that is, how to design and cut the gear teeth, how to provide for the distortion of the pinion relative to the gear, and how to overcome the difficulties due to the length of face of the gears, etc. In this direction a great deal of very creditable work has been done and many improvements of considerable ingenuity have been introduced, but, in view of all this, is it not well now to begin to realize that another phase of the problem, hitherto neglected, exists, and that is the dynamics of the geared drive problem?

In the geared drive the link between the point of application of the power to the gear and the point where the power is delivered to the water by the propeller possesses a mass of its own which is not only considerable but enormous! Take, for instance, the case of a shaft 100 feet long weighing 20 tons, whose cross section has a radius of gyration of .4 foot. On each end of this shaft is a heavy rotor. At one end it is the gear weighing 5 tons and at the other end the propeller weighing 10 tons. Let the radii of gyration of each be 4 feet. These round figures are merely assumed, although in actual practice the combination may be even worse.

With a system such as this, the mere fact that 10,000 horsepower is put into the gear for transmission to the propeller at the other end becomes insignificant if consideration is given to what is going on in the connecting system itself; that is, in the shaft-plus-gear-plus-propeller. To calculate results in connection with such a drive, and at the same time disregard the connecting system, is a waste of time. All the bearing pressures and rubbing unit stresses and so-called factors of safety are devoid of any practical meaning. For this reason it is childish to explain the failure of geared installations by such excuses as misalinement or lack of uniformity in the heat treatment of the gears, etc. Whether these are the true reasons for the failure or not is a matter of only secondary interest. The main problem is to find out first of all whether or not the system has been so designed that it can reasonably be expected to stand the work at all.

What should be realized in investigating the problem is the fact that the connecting system (that is, the shaft-plus-gear-plus-propeller) has a period of torsional vibration of its own and also possibly an overtone or two of some consequence. By torsional vibration is meant the alternate angular motion of the shaft cross sections relative to each other, the axis remaining straight, as in a torsional pendulum. It has a definite fundamental frequency, also harmonics and overtones like other elastic vibrations. As far as the slow speed reciprocating engine drive is concerned, this torsional vibration has long ago been definitely established by Frahm and others, in Europe, and more recently checked by the United States Navy Department under the able supervision of Naval Constructor William McEntee, U. S. N. But when it comes to a high-speed drive, no systematic investigation has so far been carried out.

In the case of a three-bladed propeller, such a system of

* Consulting engineer, Philadelphia, Pa.

drive receives from the outside three impulses per revolution with which to set up a forced torsional vibration of the frequency $3n$ per minute. If the shaft were perfectly rigid or very short, this would not matter so much, as it is not the impulses themselves which are transmitted to the teeth that are of interest, but if the frequency $3n$ is anywhere near that of the natural free frequency of the connecting system (that is, of the shaft-plus-gear-plus-propeller), then the blows on the teeth will increase in a proportion that will positively stagger anyone unfamiliar with the details of the phenomenon known as synchronism.

Just how heavy the blows will be is a very difficult question to answer, but it is not absolutely necessary to consider the problem from that angle. All that we need to determine definitely is the speed at which trouble will occur, so that either this speed may be avoided, or, if for some reason this speed must be maintained, means can be found by which the torsional vibration may be killed. Lanchester, the great English scientist, accomplished this result in the case of the automobile engine, so why cannot someone else do the same thing in some other manner for a geared drive?

To put matters into concrete shape, the following investigations must be made on a large scale by both the Navy Department and manufacturers:

1. Various formulae must be carefully checked by accurate experiments, giving the frequency of torsional vibration of a system consisting of a long shaft with a heavy mass on each end, but not constrained in any part of its length.

2. The fact must be established that this torsional frequency is independent of whether the shaft is at rest or is actually rotating. It will probably be easy to demonstrate that such is actually the case; then further experiments would be greatly simplified.

3. As the theoretical determination of the actual amplitudes of oscillation is a difficult matter, the limits of speed variation within which we might consider synchronism as practically taking place should at least be found.

4. The limitations, if any, prohibiting the use of a suitably designed friction clutch should be found. The friction clutch, the writer believes, is the most effective as well as the most natural means that can be used in wiping out the effect of torsional vibrations. If such a device can be used at all, the most advantageous location for it should be investigated.

5. All other means by which the torsional vibrations can be damped out should be investigated. It is not unlikely that several methods for doing this can be found in addition to Mr. Lanchester's excellent idea, which, to the best of the writer's knowledge, is patented.

The above are merely a few practical ideas which suggest themselves to the writer every time he hears of the failure of a geared turbine installation. A few theoretical considerations will appear elsewhere shortly.

Shipping Large Marine Boilers*

Herewith is presented an interesting photograph of one of thirty large marine boilers, 14½ feet diameter by 11 feet 2 inches in length, built by the Kingsford Foundry & Machine Works, which are being transported by rail for installation in fifteen vessels building at various points on the lakes. Up to very recently it was impossible to ship boilers over 11 feet in diameter from Oswego, N. Y., where the Kingsford Foundry is located, except by canal. The special car shown in this illustration, however, makes it possible to transport boilers of the dimensions stated. These boilers weigh about 91,000 pounds each; two are carried in each 3,500-ton ship. The car shown is built so that the bottom of the I-beams are only one foot clear of the rail. This allowance is necessary to get clearance under bridges and tunnels. In some instances, in fact, the boilers have clearance of only one inch, and must therefore be loaded very carefully and centrally.

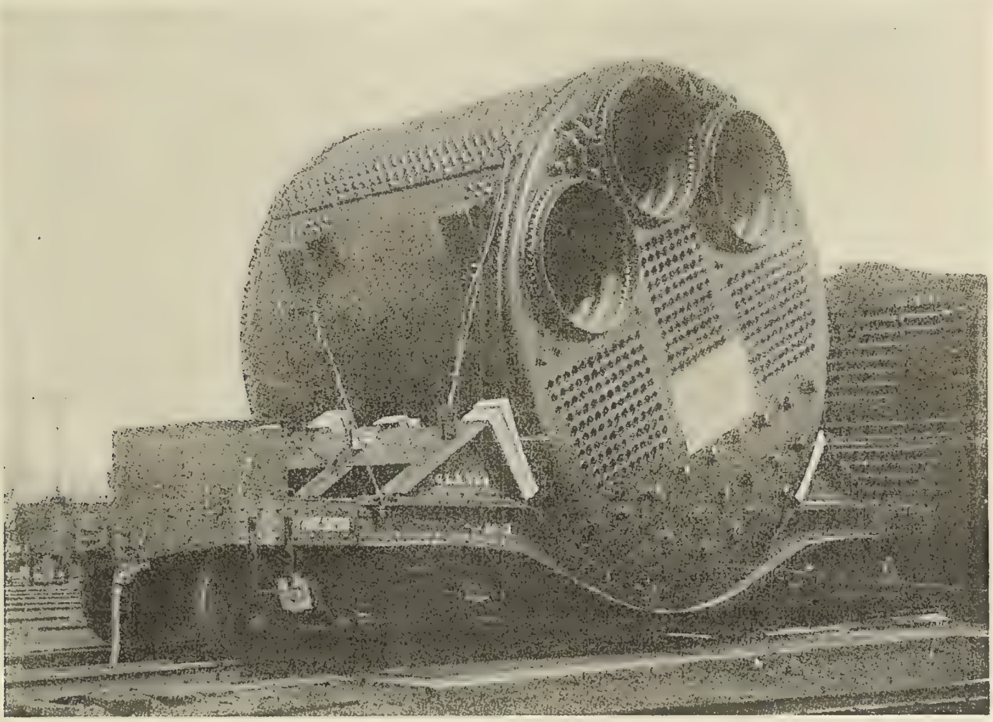


Fig. 1.—Special Flat Car for Shipping Scotch Boilers

* The *Marine Journal*.

Best Fore-and-Aft Position of Parallel Middle Body in Single-Screw Cargo Ship*

Effect of Variation of Position of Parallel Middle Body on Shaft Horsepower, Propulsive Coefficient and Propeller Revolutions

BY NAVAL CONSTRUCTOR WILLIAM MC ENTEE, U. S. N.

PREVIOUS experiments made at the U. S. Experimental Model Basin indicate† that for slow ships of full lines, such as are used for the ordinary single-screw cargo ship, it is desirable to use a certain amount of parallel middle body. In those experiments the different models used had varying lengths of parallel middle body distributed equally forward and abaft the midship section. The present investigation had for its object the determination of the best fore and aft position for the parallel part of the ship, and the investigation of the effect of this variation on the shaft horsepower, propulsive coefficient, and wake and thrust deduction factors.

Four 20-foot models were made corresponding to ships of 400 feet length between perpendiculars and of 57.3 feet beam, 26 feet draft, and 13,137 tons displacement when fully loaded. A longitudinal or prismatic coefficient of 0.788 was chosen as representing about the present practice in cargo carriers of this type. A constant length of the parallel middle body was taken equal to 33 percent of the ship's length. This percentage was found in the investigations referred to above to give about the minimum residuary resistance for the speeds attained in practice for ships of this type.

In Fig. 1 are shown the lines of model 2,023, which were used as the parent form. In Fig. 2 are shown the curves of sectional area for the four models and the parent form. Model 2,132 was made very full at the entrance, with a fine run. Model 2,135 was made relatively very fine at the entrance and full in the run. Models 2,133 and 2,134 were intermediate between the two extreme models. The model with the very full bow and that with the very full stern were purposely made of an extreme type beyond anything that might be expected to be used, in order to give a wide scope to the investigation and to insure that the limiting conditions as regards power should be obtained at either extreme.

In the four models the middle section of the parallel middle body—that is to say, the section which divided the parallel middle body into two equal portions—was placed at varying distances from the forward perpendicular, amounting to 31.3, 38.5, 53.4 and 60.5 percent of the length of the ship, respectively.

The models were carefully made and all were fitted with the same cast stern frame, which included the stern bearing for the propeller shaft. The stern frame had the rudder cast with it. The whole frame and rudder was fitted to each of the four models before the self-propulsion experiments were undertaken, and, together with the propeller shaft, propeller and dynamometer, were transferred from one model to the other as the experiments with each model were completed.

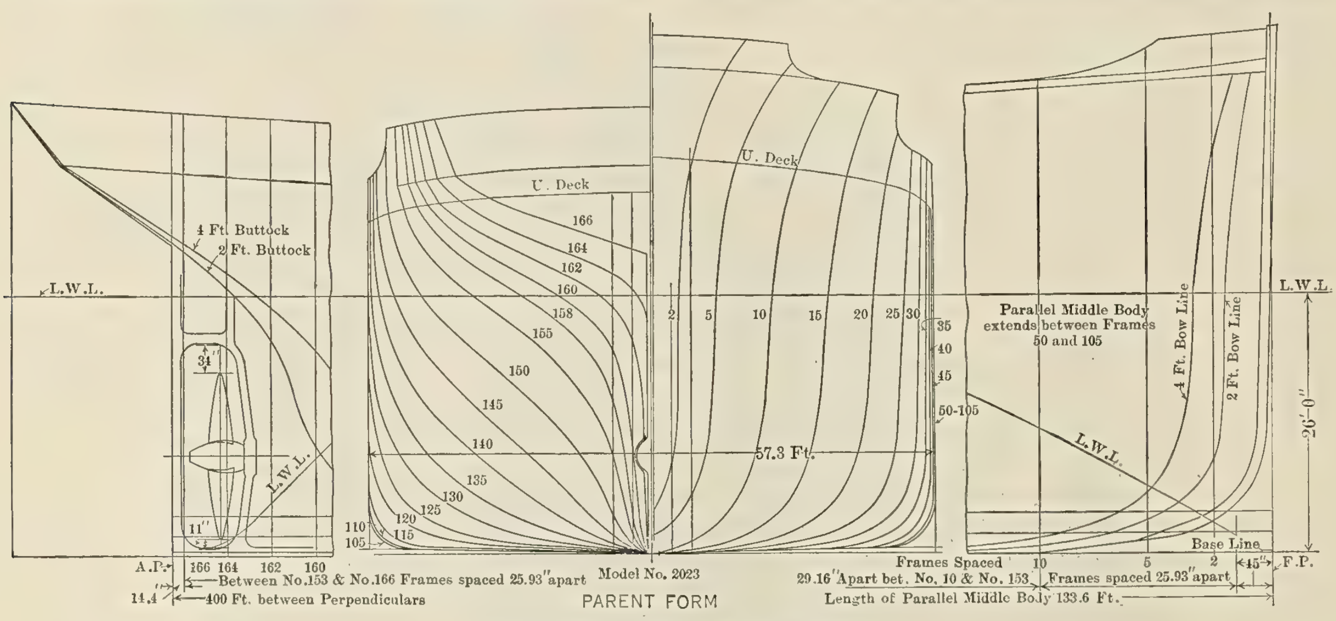


Fig. 1.—Showing Lines of Model 2,023

The dynamometer consisted of a small direct-current motor, the armature shaft of which was directly connected with the propeller shaft by means of a flexible coupling. The armature shaft was free to float fore and aft in its bearings about 7/16 inch in an axial direction. The armature shaft was connected to a calibrated spring by means of a thrust bearing, so that the axial displacement of the armature shaft gave a measurement of the propeller thrusts. Similarly, the frame of the motor was mounted so as to rotate in independent bearings. The torque developed by the motor acted against a calibrated spring so that the deflection of the spring indicated the

* Paper read before the twenty-sixth general meeting of the Society of Naval Architects and Marine Engineers, Philadelphia, Pa., November 15, 1918.

† Speed and Power of Ships, by D. W. Taylor.

torque of the motor. In addition to this there were suitable means provided for measuring the revolutions of the shaft.

The order of procedure in making the tests was as follows: The shaft and dynamometer were carefully lined up and the whole run for a sufficient time to warm up the bearings and reduce the bearing friction as much as possible. Owing to the fact that the dynamometer was similar data taken at higher speeds. The range covered corresponded to speeds of 5 to 12½ knots for the ship. About forty different runs were made with each model, giving a corresponding number of points for plotting the torque, thrust and revolutions per minute curves.

The armature of the propeller dynamometer was especially designed to reduce to a minimum the amount of magnetic thrust. This thrust increased with the torque

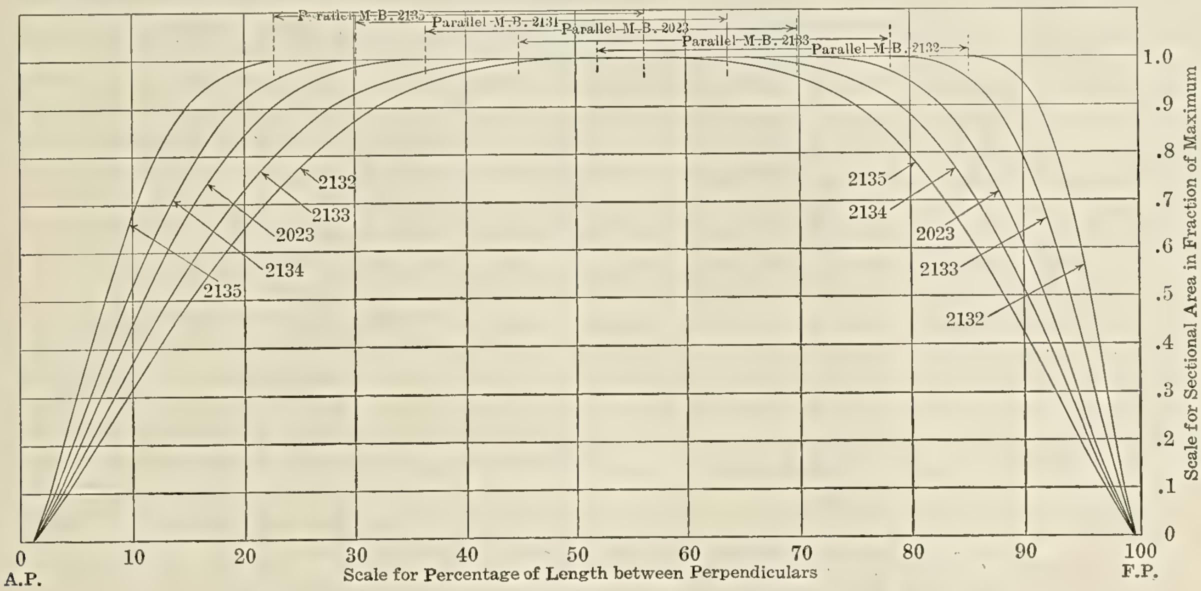


Fig. 2.—Showing Curves of Sectional Area for Four Models and the Parent Form

placed very close to the stern, but a short length of propeller shafting was necessary, and this was supported by two self-alining bearings, one at the stern bearing and the other at the forward end of the stern tube. With the propeller shaft in place and everything working freely, the model was towed in the Model Basin beneath the towing carriage at several different speeds, and the propeller shaft, without propeller, run at the range of revolutions to be covered in the course of the experiments. The propeller was then fitted to the shaft and cards for torque and thrust and revolutions per minute were taken with the model self-propelled at different speeds.

Method of Making Tests

In these tests the model was guided by two plates about 10 inches in width placed at either end of the model, so as to steer it in a straight course. The guide plates floated between the guiding points attached to the carriage, but the towing carriage did not exercise any force on the model in a fore-and-aft direction.

Starting at low speeds corresponding to about 5 knots for the ship, the towing carriage was adjusted to run at a uniform speed. The rheostat controlling the speed of the propeller dyanmometer was then adjusted so that the thrust of the propeller would just keep the model running as fast as the towing carriage, without striking the stops, which were placed at an interval of 6 inches. Thus, starting with the model in the mid position, it was free to gain or lose a distance of 3 inches as compared with the towing carriage before striking either stop. When the propeller was running at the proper speed to keep the model up with the towing carriage the record of thrust, torque and revolutions per minute was taken. If, in the course of the run, the model struck either stop on the carriage the run was discarded and another run made.

Having obtained the desired data at the lowest speed, the carriage speed was increased for subsequent runs and and amounted to 0.17 pound when the armature was displaced 7/16 inch and the torque delivered to the shaft was 16 pound-inches. Neglecting this at higher powers would have caused an error in thrust measurements of about 1.4 percent, but would not have caused any error in the power measurements. However, this magnetic thrust was separately calibrated, and corrections for it were made in working up the results of the experiments.

It is interesting to note that experiments of this kind with a very heavy model, in this case a displacement of 3,774 pounds, afford a very sensitive means of checking the uniformity of speed of the towing carriage. If the towing carriage itself were not very carefully adjusted, so as to eliminate slight variations in power required to drive it, owing to variations in the level of the tracks or uneven friction of the driving wheels or guide wheels, the resulting small accelerations and retardations of the carriage were made very apparent. As the model, driven by its own propeller, when supplied with a constant voltage, ran at very uniform speeds, it was possible to see the towing carriage gaining or losing distance of a few inches in five or ten seconds, as slight inequalities of speed due to small variations in the resistance of the driving mechanism developed. In order to conduct self-propulsion experiments successfully with the method followed, it was necessary to have the towing carriage running in excellent condition.

Immediately after completion of the self-propulsion tests on the model the propeller was removed and the runs to obtain the shaft friction and the thrust without propeller was running at the proper speed to keep the with the resistance dynamometer on the towing carriage and the usual model resistance data taken. This insured that the conditions of test both for self-propulsion and for the resistance of the model would be uniform as regards conditions of the model, temperature of water, etc. Experiments on the four models were run on succeeding days,

and the springs of the propeller dynamometer were calibrated both before and after the tests.

In Fig. 3 is shown one of the dynamometer cards taken for a model running at a speed corresponding to about 10½ knots for the ship. It will be noted that the deflection of the torque spring for this condition was 2.47 inches, for the thrust spring 2.24 inches, and the interval over which the revolutions were measured was 1.78 inches. With a little practice it was possible to read both the thrust and the torque deflections within 1/100 inch. The revolutions could be read to an accuracy of less than one-half of one percent. Considering that the data taken are plotted and the whole averaged by means of faired curves, it is estimated that the results obtained as regards the three elements measured are correct within one percent.

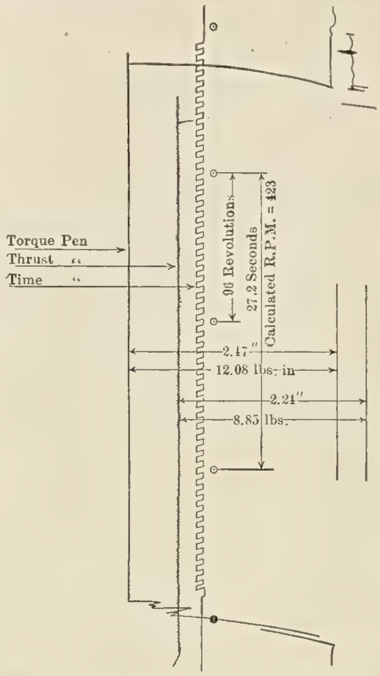


Fig. 3.—Dynamometer Card Showing Propeller Thrust, Torque, and Revolutions per Minute

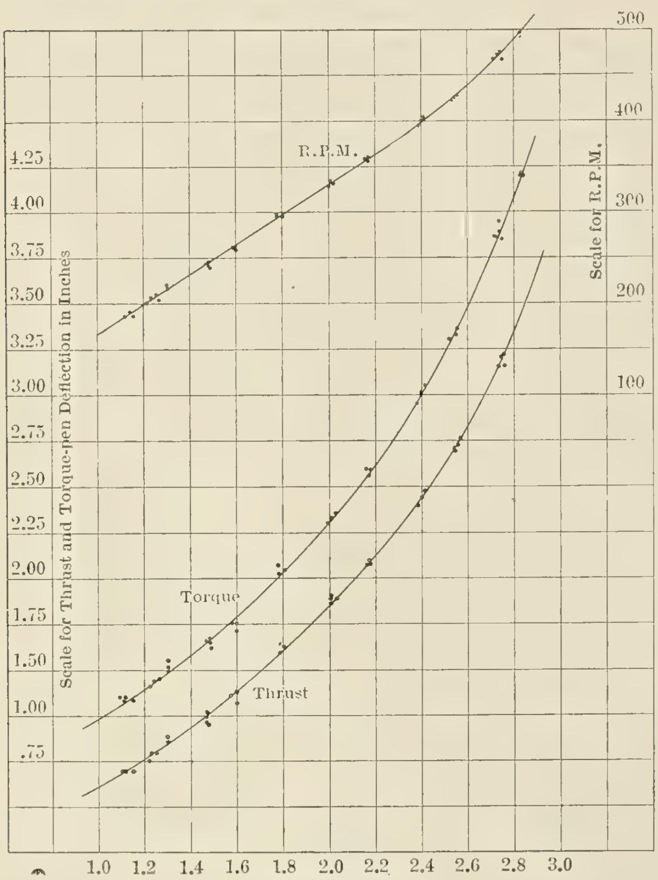


Fig. 4.—Curves of Dynamometer Thrust and Torque-pen Deflections and Propeller Revolutions per Minute. Model 2,133

In Fig. 4 are shown the actual observations of the torque and thrust pen deflections, and the revolutions per minute of the propeller shaft plotted on speed of the model, the latter being measured by the speed of the towing carriage in the same manner as in the ordinary resistance tests.

The following are the dimensions of the propeller used in the experiments and also the dimensions expanded to the ship scale:

	Model	Ship
Diameter	10.125 inches	16 feet 7 inches
Pitch	9.0 inches	14 feet 9 inches
Pitch ratio	0.889	
Mean width ratio	0.20	
Number of blades	3	
Rates of projected to disk area.	0.266	
Blade thickness fraction	0.04	

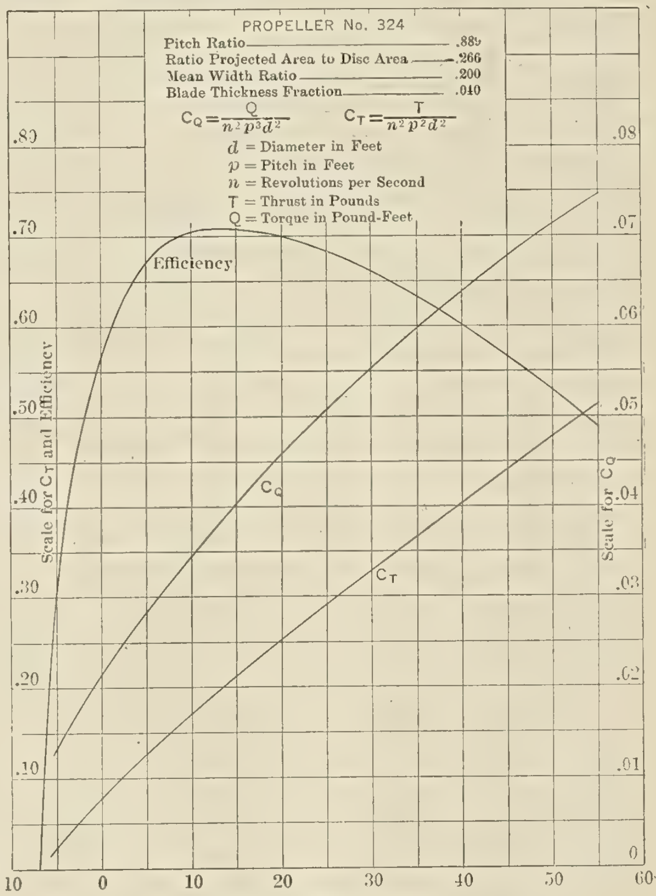


Fig. 5.—Curves of Propeller Characteristics

The propeller had three blades of Taylor's standard form.

The propeller characteristics were obtained by separate tests of the propeller model run in free water; that is, in a separate apparatus where the propeller shaft projected well ahead, so that the propeller ran in water undisturbed by the action of the testing apparatus. The same motor dynamometer was used for the tests as was used for the self-propulsion tests, the only difference being that the propeller shaft was coupled to the forward end of the armature shaft instead of the after end.

The characteristics of the propeller are given in Fig. 5. The thrust constant, C_T, and the torque constant, C_Q, are plotted on nominal slip following the method used by Schaffran.* These constants, which are in non-dimen-

* "Systematische Propellerversuche"; K. Schaffran, Schiffbau, September 22, 1915.

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sional form, lend themselves well to the analysis of self-propulsion experiments and to the extension of the results to the full size ship.

The results of the investigation are given in Figs. 6, 7 and 8. An examination of the effective horsepower curves and the shaft horsepower curves for the different models shows, as would be expected, a wide variation in power required. By plotting cross curves of power at a speed of eleven knots it will be found that for both the effective horsepower and the shaft horsepower the best results are obtained when the middle section of the parallel middle body is placed about 43 percent of the ship's length from the forward perpendicular. But 2,000 shaft horsepower is required for the ship represented by model 2,133 at a speed of 11 knots. This is considerably below

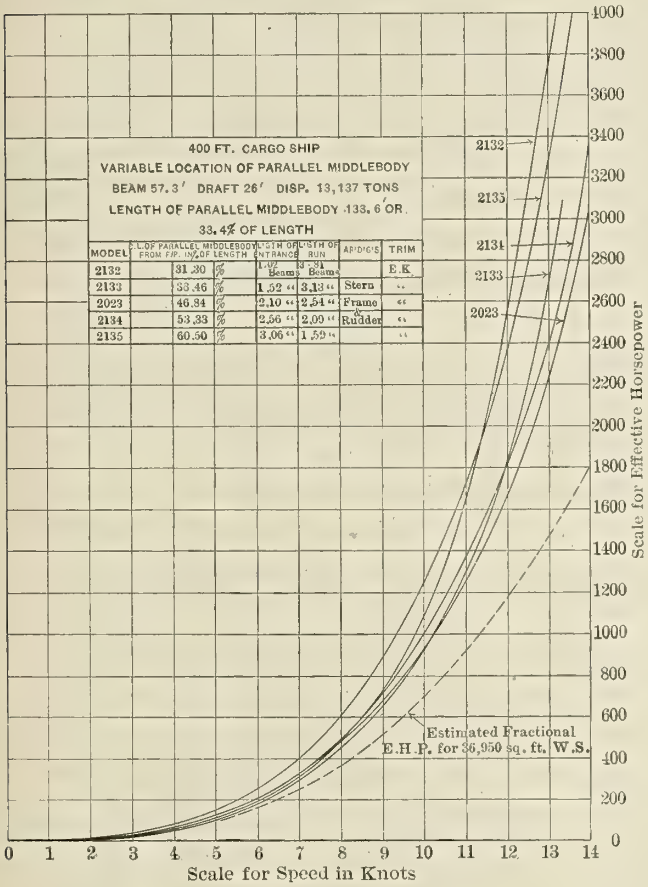


Fig. 6.—Curves of Effective Horsepower

that obtained with the ordinary 400-foot cargo ship of this displacement and may possibly be questioned as to whether it is not lower than could be expected to be obtained on a real ship. It must be remembered, however, that the lines are of good form and the friction of the shaft has been eliminated, so that the powers given do not include shaft friction. As to the reliability of the method followed, it may be stated that in similar experiments made on a model of the twin-screw collier *Jupiter*, for which are available accurate trial data, the results of the model tests, when extended to the ship, agreed identically as regards the propeller revolutions and within one percent as regards power and propulsive coefficient.

In Fig. 8 are shown the curves of wake fraction, thrust deduction coefficient, apparent slip, and true slip for the ship. In extending the results of the model experiments to the full size ships, it has been assumed that the wake fraction and thrust deduction coefficient for the ships are the same as for the models. The apparent slip and the true slip for the ship are less than for the model, because of less relative resistance, owing to the fact that the

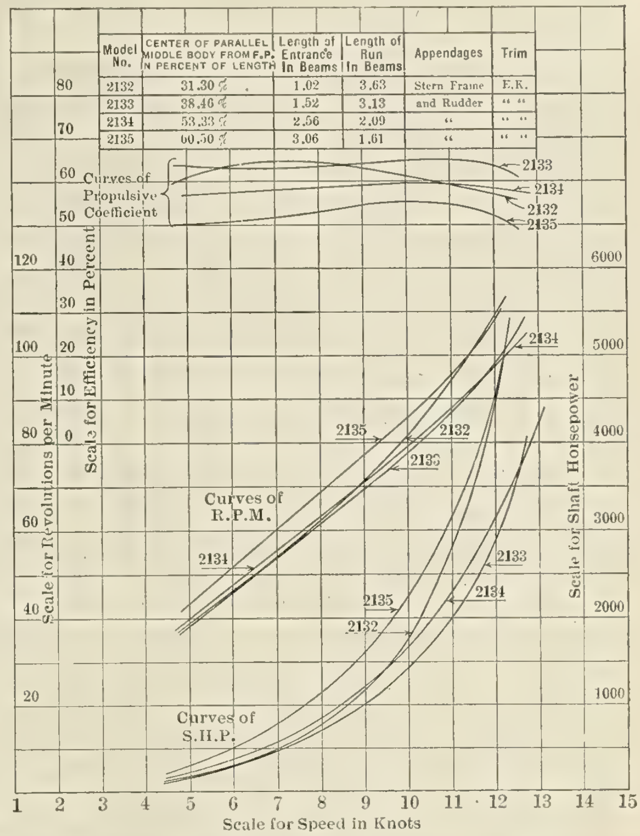


Fig 7.—Curves of Shaft Horsepower, Revolutions per Minute and Propulsive Power

frictional resistance increases less rapidly than if it followed the law of comparison.

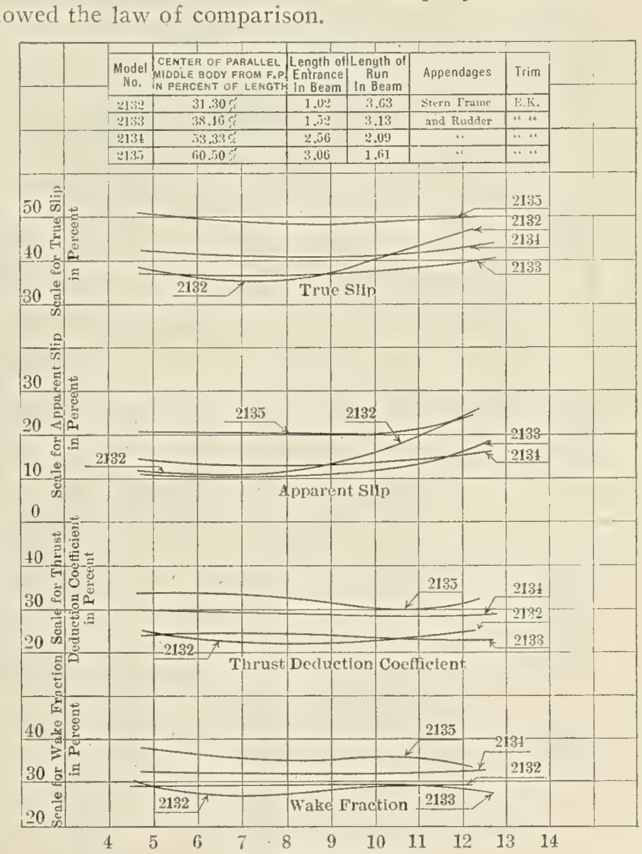


Fig. 8.—Curves of Wake Fraction, Thrust Deduction Coefficient, True Slip and Apparent Slip

In order to avoid confusion in terms, the following definitions of thrust deduction coefficient, t, and wake fraction, w, are given:

$$t = \frac{T - R}{T}; \quad w = \frac{V - V'}{V},$$

in which T is the thrust of the propeller, R the resistance of the ship, V the speed of the ship, V' the speed of advance of the propeller in the water in which it works.

As was to be expected, the wake fraction and thrust deduction coefficient both increase with fullness of the stern. It is interesting to note that in all cases the wake fraction is considerably greater than the thrust deduction coefficient, resulting in a hull efficiency greater than unity. The wake fraction obtained for the different models at a speed corresponding to 11 knots for the ship varies from 0.29 to 0.35.

The formula for wake fraction given by Taylor is as follows: $-w = -0.05 + 0.5b$, in which b is the block coefficient. This would give for all of these models a wake fraction of 0.336. The average of the results obtained in these experiments is 0.31, which is but slightly less than that estimated by the above formula.

Discussion

BY REAR ADMIRAL C. W. DYSON, U. S. N.

I have been cognizant for quite a long time of the work being carried on by Commander McEntee along the lines as outlined by him in this paper, but have never heretofore had the opportunity to scrutinize the results obtained by him except in one instance, that of the propeller designed by myself for the *Eagle* boats.

In this latter case the results obtained in the model tank agreed so closely with the estimates of performance as computed by the Bureau of Steam Engineering, and from indications obtained on the trial of the first of these vessels so closely with the actual performances, as to instill into my mind a great confidence in the accuracy and a supreme appreciation of the value of model propeller experiments as now conducted by Commander McEntee.

Close Agreement of Model Experiments with Estimate of Performance

Commander McEntee has requested me to analyze the propeller which he used in his experiments and to make an estimate of its performance behind the various hulls which he has used in order to ascertain the degree of agreement between the results obtained by the two methods. In order to give a clear understanding it will be necessary to give a brief description of the method used by me and which has been obtained by many years' study of the performances of actual propellers driving actual ships over carefully measured courses.

The form of propeller blade selected from which to derive the design or performance factors is that of which the projected area is an oval with the greatest circular width at .7 the radius of the propeller from the center. From these performances a series of basic curves of design have been obtained from which the performance of the propeller under these basic conditions can be obtained and the performance of the propeller under any other conditions of performance derived from this basic performance by the application of suitable factors entailed by the changed conditions.

The basic conditions are denoted as follows:

I.H.P. = basic indicated horsepower.
S.H.P. = *I.H.P.* × .92 = basic shaft horsepower.
P.C. = basic propulsive coefficient with maximum hull efficiency. (Taken for total projected area ratio.)
E.H.P. = *I.H.P.* × *P.C.* = basic effective (tow-rope) horsepower.
P.A. ÷ *D.A.* = projected area ratio (outside .2 diameter) of 3-bladed basic propeller.
4/3 *P.A.* ÷ *D.A.* = projected area ratio of 4-bladed screw.
2/3 *P.A.* ÷ *D.A.* = projected area ratio of 2-bladed screw.
1-*S* = 1 — basic apparent slip (for 3 blades) and for fullness of after body of vessel.
$I.T._D$ = basic indicated thrust in pounds per square inch of disk area of the propeller.
D = diameter of propeller in feet.
P = pitch of propeller in feet.
T.S. = basic tip speed (3 blades) in feet, of propeller.
v = actual speed of vessel.
e.h.p. = effective (tow-rope) horsepower for *v*.

The power required to deliver *e.h.p.* where no cavitation exists is expressed by $I.H.P._d = I.H.P. \times K \div 10^z$

where Z depends for its value upon the value $\dfrac{e.h.p.}{E.H.P.}$

and K is the thrust deduction factor.

The revolutions corresponding to the actual conditions of resistance are found by the following equations:

$$s = \text{apparent slip} = S\,\frac{I.H.P._d \times A_v}{I.H.P. \times A_V} \text{ and } R_d = \frac{v \times 101.33}{P \times (1 - s)},$$

where S is the basic apparent slip and A_V and A_v are factors depending upon the values of V and v.

It should be borne in mind that slight variations in the form of blade have only slight effect upon the efficiency so long as the same projected area is retained, but do have a considerable effect upon revolutions, therefore, we should be prepared to find but small differences between the estimated and tank powers if both methods are correct, but considerable variation in the revolutions as the propeller used by Commander McEntee had blades of the Taylor form, while the standard blade form used by me, as already pointed out, is an oval.

ESTIMATE OF PERFORMANCE—SHAFT HORSEPOWER

Hull.	v	e. h. p.	e. h. p. / E. H.P.	Z	K	Est. Power.	Tank Power.	Log A_V	Log A_v	s	Est. Revs.	Tank Rev s.
2132	8	480	.1415	.89	1.27	735	750	3.48	2.78	.09	60.4	62
	10	1100	.3243	.51	1.27	1762	1800	3.48	3.01	.1274	78.7	80.5
	12	2580	.7607	.12	1.27	4325	4500	3.48	3.23	.1885	101.6	109
2135	8	610	.1799	.74	1.41	1153	1225	3.51	2.78	.1379	63.75	69
	10	1240	.3656	.455	1.41	2220	2250	3.51	3.01	.1564	81.44	86
	12	2500	.7371	.138	1.41	4607	4550	3.51	3.23	.1955	102.5	109
2133	8	450	.1327	.91	1.27	702	725	3.48	2.78	.086	60.8	61.5
	10	925	.2727	.588	1.27	1472	1480	3.48	3.01	.1065	76.9	77.5
	11					2030	2000				86.0	87
	12	1825	.5381	.276	1.27	3020	2850	3.48	3.23	.1316	94.9	98.5
2134	8	490	.1445	.855	1.27	796	850	3.48	2.78	.098	60.9	63
	10	1000	.2949	.553	1.27	1596	1700	3.48	3.01	.1154	77.66	79.5
	12	1825	.5381	.276	1.27	3020	3150	3.48	3.23	.1316	94.9	97.5
2023	8	480	.1415	.89	1.27	735		3.48	2.78	.09	60.4	
	10	925	.2727	.588	1.27	1472	No	3.48	3.01	.1065	76.9	No
	12	1660	.4895	.326	1.27	2679	data	3.48	3.23	.1167	93.3	data

In determining the block coefficient to use for basic apparent slip, the open water (where the propeller is not covered by the limit of the load water plane of the ship) correction is applied for hulls 2132, 2133 and 2134, directly to the standard block as ordinarily obtained for hulls of the given length, beam and displacement, while for hull 2135, which had abnormally full after body lines, this same correction has been applied to an increased standard block, this block being .80 in the first three cases and .85 in the latter, the corresponding open water blocks being .532 and .61.

The work of analysis and estimate appears in the accompanying table, the estimated and tank powers and the estimated and tank revolutions being placed in parallel columns.

The hull characteristics are as follows:

$L.B.P.$ = 400 feet
B = 57.3 feet
H = 26 feet
Displacement = 13,137
Nom. B.C. = .7716
$B. \div L.B.P.$ = .1433
Stand. B.C. for K = .80
Est. Stand. B.C. for K (hull 2135) = .85
$D < \cdot 7\,H$ ∴
Stand. S.B.C. for V = .532
Stand. S.B.C. for V (hull 2135) = .61
K = 1.27, for 2135 = 1.41

The basic condition of propeller shows:

$P.A. \div D.A.$ (3 blades)	.266
D	16.583 feet
P	14.75 feet
$T.S.$	5900
$P \times R.$	1671
$1 - S$ (for S.B.C. .532)	.89
(for S.B.C. .61)	.90
V (for S.B.C. .532)	14.67
(for S.B.C. .61)	14.84
$I.T._D$	3.1
$I.H.P.$	4880
$P.C.$	.695
$E.H.P.$	3392
$S.H.P.$	4490

The agreement between the two power columns is so close, that it appears to me that Commander McEntee has developed a method for obtaining quickly and cheaply all such data as it has taken me years to collect and from the data so obtained not only to deduce absolutely correct factors for propeller design but also to classify hulls along such definite lines that the performances of combined hull and propeller can be forecasted with the minimum of error. He is most heartily to be congratulated upon the results of his labors up to the present time, and I hope and trust that he has not yet reached the end of his investigations.

Building the Ford Submarine-Chaser "Eagle"*

Simplicity of Hull Construction—Safety Devices on Unusual Launching Platform—Routing Aids Production

TANK testing is begun at station 6 and completed at the final station. The work at station 6 includes setting of deck houses and chart house, completion of some interior riveting, setting all the stern-shaft bearings and lining up preparatory to bolting, and the installation of pumps, distillers, evaporators, and fuel oil pipes and bilge pipes. At station 7 the rear two trucks of the ship's carriage are removed and the boring bar for the shaft bearings is placed, and the bearings are lined and bored. Valves are set, oil tanks cleaned, electrical work is begun, and finally the propeller shaft, propeller and rudder are set in place. The hull having in the meantime been cemented inside, the ship is ready to pass out of the assembly shop and go to the launching platform.

As soon as launched, and while on the way to the fitting-out dock, the ship is inspected in detail, and various minor operations are carried on to get the hull ready for the installation of machinery.

Hulls Checked Up by Transit and Level

After experience in hull erection showed that complete assembly of the main framing at station 1 was not possible, it was discovered also that slight changes of position of the hull were likely to occur at all of the stations. A daily check-survey system was therefore established, in order to make sure of maintaining position and alinement. A survey corps checks up level and line of keel and verticality of frames and centerline daily, making the rounds of the twenty-one hulls. Any misadjustment is at once corrected by the wedge keel blocks and by shores.

Removal of the last two trucks of the carriage at station 7 results in a slight deflection of the stern portion of the ship, which is important with respect to the subsequent setting of the turbine reduction gear. Care must be taken to see that the stern does not drop below its position when afloat and ready for the gear installation. The shaft bearings being bored at station 7, the adjustment of the ship to its buoyancy distribution after launching tends to raise the forward end of the shaft and bring the turbine gear foundation slightly low. In this position of parts the gear is easily adjusted by shimming to correct alinement with the shaft, and all risk is avoided of having the shaft so low as to require cutting down the gear foundation in order to line up the machinery.

Drive 20,000 Rivets Daily at Each Station

About 243,000 rivets, most of them ½-inch and ⅝-inch, are contained in the "Eagle," and of these more than 200,000 must be driven on the hull erection carriages. For the ultimate rate of production of the plant—one ship a day—it will be necessary to drive more than 20,000 rivets daily at each of nine stations (stations 3 to 5 on three working lines). In view of the magnitude of this daily task, the rivet handling methods are especially interesting.

By far the greater proportion of the rivets are countersunk, with a 60-degree angle of countersink and with point shaped to ⅛-inch rise. This "mushroom" point gives greater strength than a flush point, and also makes the driving easier by the use of a slightly cupped rivet set in place of a flat one.

All rivets as received are cleaned of dirt and loose scale in two tumbling barrels set up in a rivet handling inclosure near the center of each supply bay. From here they are distributed, in bright and clean condition, to their various stations. If used in the heaters in the condition as originally received, scaling would cause constant trouble in the heater.

* Abstract through courtesy of *Engineering News-Record.*

Electric rivet heaters are among the remarkable innovations in the "Eagle" manufacture. They were designed by E. F. Allison, chief electrician of the Ford Motor Company. Such a heater comprises a simple transformer whose secondary circuit terminates in a jaw having upper and lower contact plates, the upper one spring-mounted, between which the rivet is placed in vertical position. The contact resistance of the large current flowing through the rivet produces the proper riveting heat in about 30 seconds—just time for taking the hot rivet to the ship and returning to the heater for the next. Heating is most rapid at the point, the head brightening up last.

A convenient riveting scaffold is another innovation. It consists of hook-ended hangers with laterally projecting bolts, and similarly hook-ended bracket members, which can be placed instantaneously. The hangers are hooked over the top of the shell; extension lengths can be hooked to their lower ends just as easily.

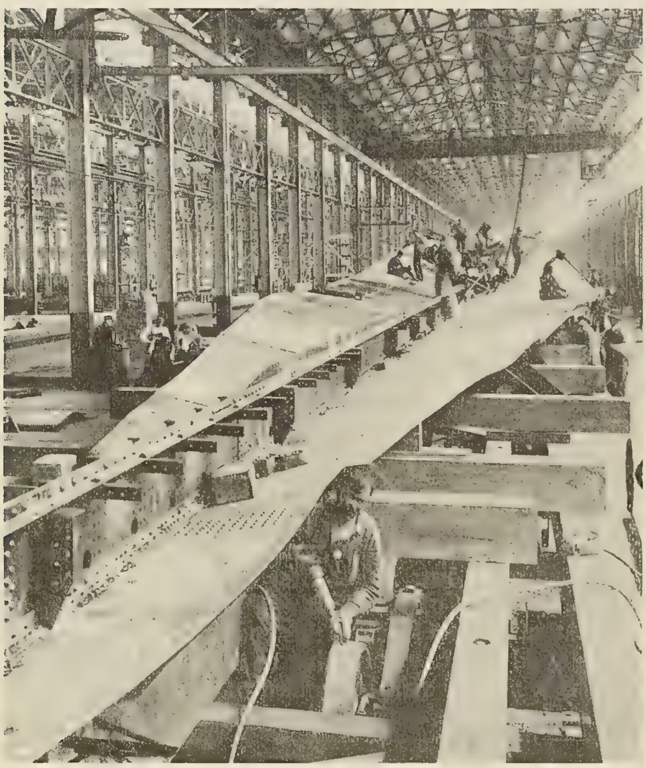


Fig. 5.—At Work on Keel and Bottom Plating

A sharp departure is made from the ordinary shipyard practice of countersinking the plates in the punch shop before they come to the ship. At the "Eagle" plant the countersinking is done on the ship, when the plates are in place. It is combined with the operation of reaming, through the use of a reamer shaped with a countersink taper in its rear portion; a stop on the tool assures correct depth of countersink. One advantage of this procedure is that perfectly true countersinks are obtained, whereas when the countersinking is done in the punch shop the subsequent reaming of holes not perfectly matching shifts the axis of the hole and results in forcing the head to one side of the shaft of the rivet. This gain in rivet quality, and the elimination of such errors as countersinking the wrong side of the plate, which may occur in the case of shop countersinking, are decisive advantages, although the hand countersinking proved to be rather heavy work in the 12-pound shell plating.

With all frames straight, with no plates except those of the bilge strake requiring to be curved in bending rolls, with only four furnace plates under the keel (one of these is die-forged in an outside plant and is received at the "Eagle" factory ready shaped), the manufacture is largely reduced to simple punching and assembly work arranged in the manner described. Furnace bending is practically limited to the shaping of the watertight boundary angles of the bulkheads. Only one set of bending rolls is provided in the punch shop, which is sufficient to take care of the bilge plate. Flanging the frame members and brackets is done cold by two large plate benders.

Simplicity of the Hull Construction Work Largely Due to Design

These elements of simplicity are to be credited to the Navy Department's original design, which, as already stated, was conceived with factory production in view. Notable elements of the design, besides those mentioned and those represented in the frame section, are the use of V-shaped keel plates, the avoidance of forgings and complex plating at stem and stern, straight-line longitudinal shaping so that both bottom and shell plates can be drawn into position directly from the flat, and elimination of joggling by using short, tapered liners, not only at butt laps but also on the frames, under the out-plates of the shell, these plates being drawn in to the frames. The boundary angles of watertight and oiltight bulkheads are stapled to fit the plating.

Unusually numerous lightening holes in floors, frames, brackets, etc., are called for by the design. They are produced very expeditiously, however, and do not make the shop work less simple. The smaller holes are stamped out while the larger one are burned out with oxy-acetylene flame. Flame welding is also used extensively, chiefly for the corners of bulkhead angles and similar work.

Plates ranging in weight from 6 to 12 pounds per square foot make up the structure of the ship. Stanchions are made of tubes pressed flat at the ends for riveting to angle clips at the floor and deck connections. Making the keel plate part of the shell plating eliminates the necessity for edge-planing, as required in ships of ordinary design at the junction of keel and shell plate. A warped surface occurs in the rear portion of the ship's bottom; the shell plating here can be drawn down to the frames without difficulty, however.

Laying Out Plating by Graphical Projection

When the designers in the Ford Motor Company's ship-drafting force carried out the detailing and undertook to work out the plating for a maximum amount of multiple punching, they found a considerable gain in accuracy by laying out the plating on the drafting board by graphical projection to a scale of 3 inches to the foot. The results of this process checked against the mold loft layout proved to give superior accuracy and furnished a satisfactory basis for fixing the dimensions of plate and laying out the riveting.

In the search for further simplification of manufacture, electric welding of bulkheads, deck houses and other parts not calling for great structural strength is being introduced. The stimulus for the attempt came partly from the successful ship work done in England in electric butt welding. Recently a complete athwartship bulkhead was made up by welding, and steps were taken to systematize the work for regular application.

"Quasi-arc" welding is used. The joints of the plating are butt welded, while the boundary and stiffener angles are attached by edge welding and intermediate welding, as sketched. The first intermediate welding tried was like that used in the English experiments, the angle leg in con-

tact with the plate being notched, so as to bring part of the welded toe edge close to the position of the ordinary rivet line. As an improvement on this, elongated holes were punched in the angles, and the edge of the angle along the inside of this hole was welded to the plate.

From the last station of the assembly shop, the completed hull passes out through one of three large steel rolling doors in the end of the building—the largest steel curtains ever used— and, still mounted on its carriage, moves forward for transfer to the launching platform.

This operation is accomplished by a transfer table which, except for its length, 200 feet, is precisely like those used in locomotive shops. It runs on 11 rails transverse to the axis of the plant, and is carried by two wheels per rail, one of the two being driven from a longitudinal shaft connected to an electric motor at mid-length. The deck carries four rails, two for the hull carriages and two for the outriggers or steadying plates of the carriage. Forward of the transfer table, at its right end, is the launching platform, to which the ship is moved over a short length of approach track.

W. B. Mayo, chief engineer of the Ford Motor Company, is credited with originating the idea of lowering the finished hulls into the water by a vertically moving hydraulic elevator. Carried out with remarkable excellence of detail, the scheme has proved completely successful.

This platform is a steel truss bridge 200 feet long, supported at the quarter points of its length by two transverse trusses whose ends, 14 feet out from the bridge trusses, are attached to two vertical 4-inch hanger rods, which are the piston rods of vertical hydraulic cylinders. Concrete pedestals 8 feet high above water support these cylinders; the deep slot between the two pedestals of each pair, extending to the bottom of the slip under the bridge, gives space for the ends of the cross-frames of the bridge as the lowering proceeds.

In the operating house, on the bank alongside the launching platform, is a duplex high-pressure pump furnishing water at pressures up to 500 pounds. A control stand with four pairs of valves provides for independent operation of the eight cylinders, but an ingenious dial indicator directly in front of the control stand shows by four separate hands the position of each pair of pistons and of the center point of the platform. The operator is able to keep the platform level within ¼ inch. About thirty minutes' time is required for the complete launch.

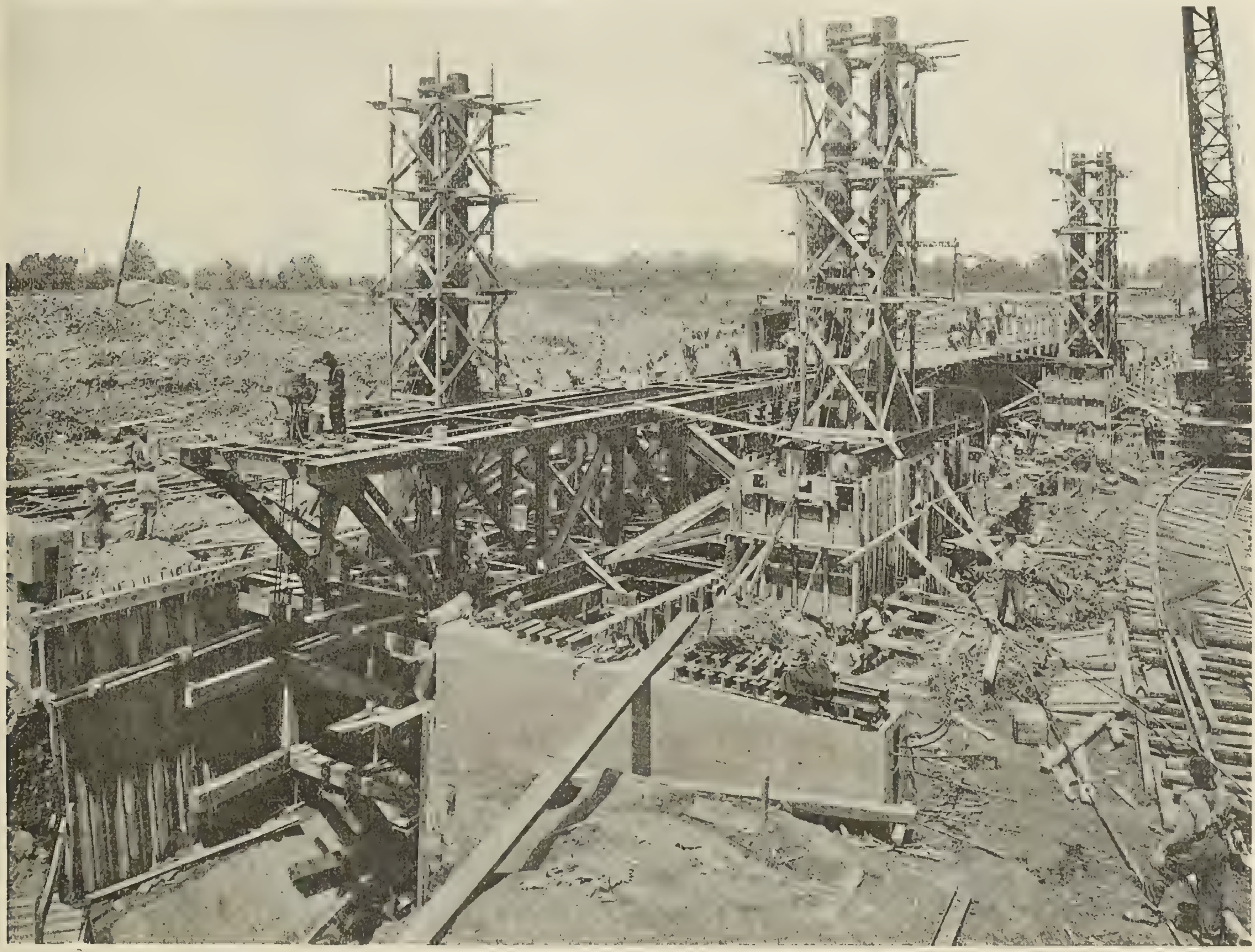


Fig. 6.—Launching Platform and Hydraulic Jacks During Early Stages of Construction

SAFETY DEVICES CONTROL LAUNCHING PLATFORM

Two mechanical safety devices are embodied in the launching platform construction. To take the weight of the empty structure when in its normal (upper) position, a supporting girder is placed under each end, bridging the width of the gap between lateral forward extensions of the abutment pier. This girder can be pulled back out of the way—after the platform is raised an inch or two—by pulling-screws engaging the ends of the girder and a pair of upward-projecting lugs fastened to the back of the abutment. Further, locking bolts pass through links in

the eight piston-rod hangers. The pistons cannot be lowered until these bolts are withdrawn. Two hand levers at each pair of cylinders are provided to actuate the bolts.

Saving labor and time in the fitting-out operation is accomplished by virtue of the progressive system of layout and working, with little aid from mechanical appliances. The work of installing the machinery and fittings of the ship and placing its many pieces of equipment is broken up into a succession of segregated items, carried out in seven consecutive positions of the ship alongside the 2,000-foot fitting-out dock.

Systematization in the Fitting-Out Plant

To characterize the arrangement of these operations, the following partial schedule of items performed at its seven stations (stations 9 to 15) is quoted:

Installing boilers, uptake and mounting is the principal piece of work at station 9. The deck over the boilers is riveted, boiler piping and a considerable amount of other interior installation are placed, and anchors and windlass are added to the ship. At station 10 the steam turbine and its reduction gear are set, shafting and the bulk of all the piping are installed, the chief electrical work in the ship is done, and the stack is set. Most of the furring is placed at station 11, and the air test of various compartments is made. At station 12 many items of rigging are put in place, from ventilating cowls to masts, spars and davits; fire extinguishers, whistle, plumbing fixtures and radiators are set, and the ice machine is put into the ship. Some electrical work is also done at this station. Other items of equipment and part of the naval installation are set in place at stations 13 and 14. Making the ship ready for sea begins at station 14 with loading the fuel oil tanks. At station 15 the final items in this part of the work are performed, including raising steam and testing the piping.

Special Handling Machinery

Long sheds built on the fitting-out dock, some 20 feet inshore of its face, supply the materials and equipment in corresponding order. A locomotive crane running on a track on the dock in front of the sheds handles the material into the ship.

Ford factory methods find application in a special rig used at the first of the seven stations, where turbines and boilers are installed in the ship. It serves for assembling the boilers, which arrive as drum-and-tube units without casing. The steel plate and firebrick casing must be built up around the steam element before the boiler is transferred to the ship. For this work an assembly skidway is provided in the shed. It consists of a pair of I-beam rails mounted on low concrete pedestals, and extends about 100 feet longitudinally down the shed. The boiler casings are built on small flat-wheeled carriages running on the skidway, as sketched.

Boilers Routed Through Shop

Starting at the middle of the length of the skidway, the boilers are built up progressively and are shifted step by step toward the ends, going to different workmen for successive operations in the assembly. They reach the ends of the skidway in finished form, and here are run out through a door in the front of the shed by means of a transfer table composed of a length of skidway mounted on wheels. With ideal working of the system the two boilers required for a ship are started simultaneously at the middle of the skidway, and several days later are completed and pass out of the shed at the same time, so that they can be set in the ship during its one-day stay at that station.

Supply of hull material to the "Eagle" plant is provided for by a punch shop that is easily among the largest in the world. As early as two months ago this plant was turning out material at the rate of 160 tons per day. On the basis of completing one "Eagle" daily, the ultimate production of this shop will be about 200 tons, a production that is being approached rapidly. Because the "Eagle" plating is only one-third to one-fourth as thick as that of steel merchant ships, the capacity of the shop in terms of ordinary ship material is 600 to 700 tons per day, or 15,000 to 20,000 tons a month.

Multiple punching is the basis of the shop equipment. When the work in the designing room had demonstrated that a large part of the shell and deck plating of the ship could be multiple-punched, ten machines for the work were fitted up from sheet-metal punch presses of the Ford Motor Company's automobile works. Thomas spacing tables were added at the feeding-out side, and the necessary gangs of punches with gag levers were built into the frames.

Shop Is Well Planned

The shop is a timber-frame building about 100 by 450 feet, its long dimension set across the direction of travel of the material. At its rear, facing the storage yard, a lean-to 60 feet wide extending all the way across the building provides space for marking out and for a considerable amount of single punching. There is a smaller lean-to on the opposite or forward side of the building.

In the storage yard back of the punch shop the plates are piled flat (not set in racks), and many of them are handled into the shop by hand. Locomotive-crane tracks traverse the yards at right angles to the longitudinal alinement of the plant, to place material in storage from cars or to assist in handling it into the shop.

In the rear lean-to of the punch shop are installed eight single punches, two plate shears and one circle-cutting shear. Most of the space of this lean-to, however, is devoted to marking the single-punched plates, which is done by center punching through metal templets. These templets are stored in racks alongside the punch table. Material passes forward from here on small hand trucks and roller beds to the punches in the main building.

Multiple Punches Dominate Shop

In the shop itself, the multiple punches dominate the arrangement. There are seven plate multiples, most of them of 72-inch gap. The plates to be punched average about 50 inches in width and usually require a gang of about 24 punches; they are fed through by hand. In addition there are three narrow multiples, eight single punches, one angle shear and punch, one blocking-out press, a horizontal punch for curved angles, two plate benders (flangers), one set of bending rolls, a pair of small furnaces with bending slabs adjacent, and a row of blacksmith forges. In the shed on the outgoing side of the punch shop are two plate-edge shears.

No storage space for finished material is provided at this shop. The outgoing material is handled directly on small railway trucks into the assembly shop, where it is taken down the supply bays to storage adjacent to the station where required for erection.

An important improvement is being made in the punching of narrow plates and frames by the use of a special automatic spacer, capable of dealing with plates not ordinarily adapted to multiple-punch work. This ingenious device, originated by Joseph Dorschel, superintendent of the shop, punches plates in which the transverse lines of holes are not exactly at right angles to the longitudinal axis of the plate.

A New Automatic Spacer in Use

Between the rails of the feeding-out bed of the press is laid a metal pattern, over which rides a small carriage attached to the leading end of the plate to be punched. A handle on this carriage serves for pulling the work plate forward through the punch. A transverse row of small vertical plungers or detector fingers is spring-mounted in this carriage, and adapted to enter holes in the pattern. As the work plate is pulled forward, one of these fingers dropping into the hole in the pattern stops the work. At the same time the punch operator sees the end of this finger depressed, and he pulls the corresponding gag lever of the punch, thereby producing a hole in the work plate corresponding in location to that of the pattern. As he does this, the feeder lifts the pulling lever, thereby disengaging the depressed finger, and pulls the work forward until another finger finds a hole in the pattern. By this arrangement, punching of holes irregularly arranged along several longitudinal lines is easily done, with accurate spacing; marking out is eliminated.

Working Force at the "Eagle" Plant

Estimates of operating organization call for a total force of about 11,000 men to operate the "Eagle" plant. The probable ultimate force will include about 9,000 men in hull construction, and something more than 1,000 in the steam engineering work. A labor force of about 100 per station of the assembly shop will be required in each shift.

Work is carried on continuously through the twenty-four hours in three shifts—day shift, 7 to 3; evening shift, 3 to 11, and night shift, 11 to 7. The day shift force is one-third larger than those of the other two shifts.

Riveters Are the Main Problem

Riveters have been the main problem of the "Eagle" plant, as they have of regular shipyards. In the words of William Knudsen, superintendent of the plant: "We know we can punch 200 tons per day, and we know we can erect 200 tons per day; the pinch is in riveting. We are now driving 86,000 rivets per day at the maximum [this was in September.—Editor], and we want to reach 240,000 rivets per day. We are putting on green men at the rate of ten gangs per day, training them in the assembly riveting for final transfer to riveting on the hulls. An ultimate force of about 500 gangs of riveters is needed."

Considerable help was given to the organization of the plant by the transfer of about 40 skilled shipbuilders from United States navy yards, to act as instructors and help develop the working organization.

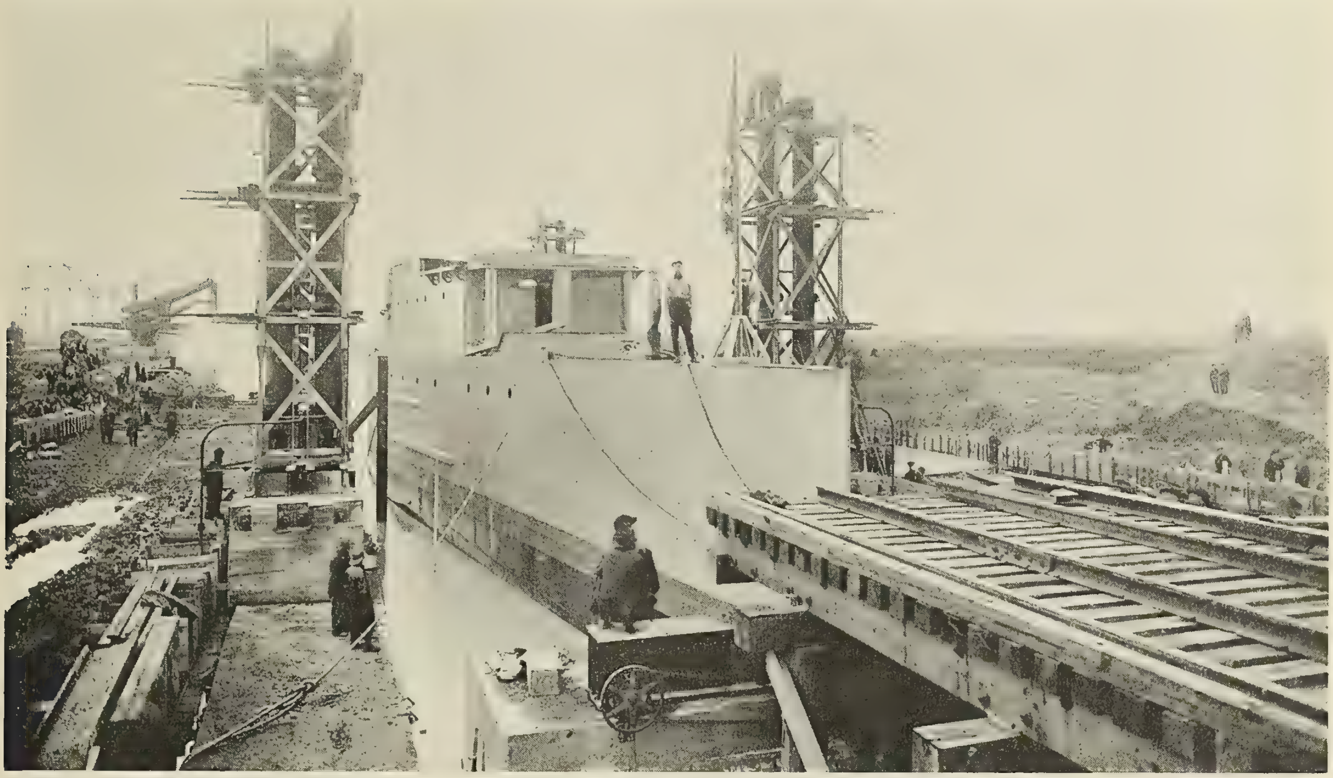


Fig. 7.—Ford "Eagle" Being Lowered, or "Launched," on Hydraulic Platform

Production Results Are Phenomenal

An outstanding feature of the organizing work is that hull construction did not begin until May 1, and that within four months from this time an organization of 6,000 had been created and was successfully producing "Eagles." Almost none of the entire force had prior shipyard experience. The building up of this great working force proceeded in spite of the fact that no housing facilities are available locally, and when construction began the nearest street-car line was about a mile from the yard. Since that time special provision has been made for transporting men to their work, and recently a street-car line has been extended directly to the plant.

The raising of censorship now permits news of the superdreadnought well toward completion at the Newport News Shipbuilding and Drydock Company. The keel of the 33,100-ton battleship was laid after this country went to war, and the vessel will be ready to launch within a few months. The main armament will consist of twelve sixteen-inch guns mounted in four turrets on the center line, two forward and two aft. Naval officials believe she will be equal to any warship on the seas.

CAR RECORD

(1) CAR No.	(2) INITIAL	(3) ORIGIN	(4) DESTINATION	(5) MILL	(6) ORDER No.	(7) DATE ENTERED	DATE SHIPPED	DATE REC'D	(8) GROSS	(9) PLATE	SHAPE	BARS	(10) 87	88	89	90	91	92	93	94	95			ROUTING
6598	P+LE	MUNHALL Pa.	YARD	Homestead	3147	3/14	3/9	3/23	107040	✓			309	23.5										U.RR-PRR-L.I.
276803	PRR	"	Fabricator	"	3147	3/16	3/12	4/11	113830	✓	✓			21.0	35.0									URR-PRR-NYNH+H
150888	B+O	POTTSVILLE Pa.	"	Eastern S. Co	3149	3/18	3/5	3/16	77719				200	18.8										P+R C of NJ-N.H.
325468	NYC	MUNHALL Pa.	"	Homestead	3147	3/18	3/10	3/24	111050	✓			17.0	20.0	18.5									URR-PRR-NH
580475	PL	"	"	"	3147	3/18	3/10	3/24	105630	✓			32.1	10.0	10.7									Do
6045	L.V	"	"	"	3147	3/18	3/10	3/25	110100	✓			15.0	20.0	20.0									Do
17829	GT	"	"	"	3147	3/18	3/10	4/5	103080	✓			18.3	12.2	21.1									Do
47898	P+R	Pottsville Pa.	"	Eastern Steel	3149	3/18	3/11	3/23	87450		✓		12.3	18.1	13.4									P+P-C of NJ-NH
387450	PRR	Phoenixville	"	Phoenix	3148	3/18	3/13	3/20	98750		✓		18.0	15.2	16.6									P.R.R C of NJ NH
380672	PRR																							
273800	PRR	"	YARD	"	3148	3/19	3/16	3/26	74830		✓		12.0	14.3	11.1									P+P-C of NJ-L.I
47630	P+R	"	"	"	3148	3/19	3/16	3/29	82170		✓		11.0	13.8	16.2									Do

Form A.—Showing Car Record

CAR TRACING SHEET

DATE ____________

SHEET No. 1

U.R.R.-P.R.R.-N.Y.N.H.+H.

			HOWARD			PITCAIRN			ALTOONA			MARYSVILLE HARRISBURG			WEST MORRISVILLE			GREENVILLE			WESTCHESTER			BRIDGEPORT		
DATE	CAR No.	INITIAL	DAY	TIME	TRAIN	DAY	TIME	TRAIN	DAY	TIME	TRAIN	DAY	TIME	TRAIN	DAY	TIME	TRAIN	DAY	TIME	TRAIN	DAY	TIME	TRAIN	DAY	TIME SET	ORIGIN
3/12	276803	P.R.R.	3/12	✓	2252	3/13	5 50 A	PG				3/M 14	8 25 P	PG2 1463	4/5	4 55 A	1131	4/8	2 00 A	FL 51	4/10	5 40 A	X78	4/11	2 00 P	MUNHALL PA

Form B.—Showing Car Tracing Sheet

Control of the Construction of a 5,000-Ton Deadweight Fabricated Steel Ship—V

Forms for Following Up Movement and Arrival of Steel Parts—Railway Shipments of Plates and Sheets Traced

BY FABRICATOR

PREVIOUS articles have disposed of the method of controlling the routine followed preliminary to securing the materials in the proper sequence and in time to meet requirements. The method of purchasing or securing the materials is a simple and direct routine, with success solely dependent upon the personalities of the individuals responsible, so the method will not be covered in this series. The problem of storing and issuing the material after its arrival is comparatively simple and depends on the yard equipment—mechanical (and mental)—but recording and following up the movement and arrival of the various items, particularly steel, is a problem which requires special consideration. Only the steel records will be covered, but the methods outlined can be applied to any of the other items.

It is necessary to know when the mill will roll and ship each item and how long it will require the transportation company to make delivery, so as to know when each item will be available at the yard. The mills will submit an approximate rolling date for individual items when they cannot meet the customer's required delivery date for the total order, which, with our previous delivery schedules, covers the first condition.

On all shipments a reasonable time is allowed for delivery by the railroad company before tracing is started, unless the shipment is very urgent; then it may be traced by telegram through the car record of the railroad office or by a car tracer, who follows the cars personally. This last is quite expensive. A detailed record of the contents of each shipment completes the conditions.

When a shipment of steel is loaded a "shipping manifest" is sent by the mill to the yards, which bears the date of loading, the car initial, number and capacity, the point of origin or location of the mill, the destination and initials of the railroads over which the shipment is routed and a full detailed description of the contents of the load. This description covers the customer's order number or numbers against which the shipment applies; the mill order number; the number of pieces, dimensions, weight and marks of each item; the hull number, total number of items and total weight. This manifest is numbered consecutively by the mill and this number and the date of the manifest should always be used when writing the mill concerning the shipment.

Immediately upon receipt of the manifest at the yard it should be entered upon a "Car Record" sheet (Form A). The first five items need no explanation. The sixth is the yard Purchase Order Number. The first item under seven is the date the entry is made, the next the date shipment was made from the mill, and the last one the date the shipment was received. The eighth is the gross weight of shipment in pounds. The ninth describes by a check mark the contents of the shipment. The tenth is a distribution of the shipment in tons over the various hulls. The eleventh is the routing of the shipment to destination. This record covers the movement of all steel to both the fabricator and yard and is used as a "follow-up" on shipments and as a basis for a "Weekly Report of Steel Situation."

Fifteen days were allowed for delivery to either the yard or fabricator before a tracer was started. This allowed a

TO Steel Co

PLEASE FURNISH FOR ACCOUNT OF THIS COMPANY ORDER NO. 3147 SHEET NO. 10

MATERIAL FOR HULL NO. 87 to 95 Inclusive (AMOUNT FOR 1 HULL) DATE Jan 18th 1918

ITEM		NUMBER PIECES	LENGTH INCHES	LENGTH INCHES	WIDTH INCHES	WIDTH INCHES	GAGE	TAPER	MARKS	ESTIMATED WEIGHTS SINGLE	TOTAL
		FLAT KEEL PLATES									
1		1		296	"		15/16		SK 4	4520	4520
2		1		355	"		"		SK 5	5400	5400
3		1		320	"		"		SK 6	4870	4870
4		1		325	"		"		SK 7	4930	4930

Form C.—Material Schedule Covering Plates

TO Steel Co

PLEASE FURNISH FOR ACCOUNT OF THIS COMPANY ORDER NO. 3149 SHEET NO. 508

MATERIAL FOR HULL NO. 87 to 95 Inclusive (AMOUNT FOR 1 HULL) DATE Jan 19th 1918

ITEM		NUMBER PIECES	MATERIAL	DIMENSIONS	WEIGHT PER FOOT	LENGTH FEET	LENGTH INCHES	MARKS	ESTIMATED WEIGHTS SINGLE	TOTAL
		VERTICAL KEEL ANGLES								
131		1		3½x3½x7/16	9.8	27	2	VKA9-22	266	266
132		1		4x4x½	12.8	22	7	9-19	288	288
133		1		4x4x9/16	14.3	42	11	19-38	612	612

Form D.—Material Schedule Sheet Covering Shapes

STEEL REPLACEMENTS AND CORRECTIONS

HEAT No.	MILL INVOICE No.	MILL INVOICE DATE	CAR No.	CAR INITIAL	DIMENSIONS ORDERED	DIMENSIONS RECEIVED	MARK	LETTERS				REPLACED DATE	REPLACED CAR	REPLACED INITIAL
✓	HD19300	3/28	859303	P.L.	243½X49X9/16	MISSING	SLD-5	7/5	7/6	7/1	7/16	8/18	10972	B&S
✓	HD15428	3/13	282443	P.R.R	275x40½x3/8	"	FL-41	5/8	5/18	6/5	7/5	7/12	315131	PRR
14785	HD16070	3/15	324921	N.Y.C.	333x57½x5/8-2Pcs	333x57¼x5/8	SA-11	7/1	7/13	7/18		9/29	29728	C.&O 2Pcs
✓	HD15428	3/13	282443	P.R.R.	67x39x3/8	MISSING	KB-51	5/8	5/18	6/5	7/5	7/12	315131	PRR.

Form E.—Steel Replacement Sheet with Data to Adjust Missing or Faulty Shipments

safety factor of fifteen days, as thirty days were allowed on the schedule for railroad deliveries.

A "Car Tracing Sheet" (Form B) was made up for each routing, showing all passing points. This was used when a shipment was behind its fifteen-day schedule, or in case a very urgent shipment required "wire tracing." Referring to Form A, Car 6598 was in one day ahead of schedule and so does not appear on the sheet, but Car 276803 was about fifteen days behind schedule. This was entered on Form B, and on tracing was found to have moved nicely till it reached West Morris, where it had been shopped. In this case a personal investigation was made and it was found that the draft rigging of the car had been seriously damaged. The railroad company offered to transfer the load, if repairs were not made by a certain date, which was not required.

Form C is a "Material Schedule Sheet" covering plates, and Form D is one covering shapes; supplementary sheets were also made on a duplicating machine and ruled so as to face the Forms C and D when bound in the binders. The car number and initial of each shipment was entered at the top of the sheet; the material mark was entered in the left-hand margin to facilitate checking and number of pieces of each item entered under the car in which they were shipped and opposite the material mark. The date the car arrived at its destination was entered in the top margin opposite the car. This gave at a glance the condition in detail of any item.

Discrepancies and shortages in shipments occur which need immediate action, and the burden is on the yard, as the mills meet all such reports with prompt action and investigate at their convenience. For this reason all items which do not check in dimension should be placed in a "hold over" pile; a record made of the heat number or other marks of identification, and this, together with the differences, reported immediately to the mill. To simplify this work (Form E) a "Steel Replacement" sheet was provided, which carried all of the information necessary to support a claim for variation in dimensions or a shortage caused by a missing item. This saved the labor of going over all of the records in order to work and close a claim.

WEEKLY REPORT OF STEEL SITUATION

TONS REQUIRED
PLATES 1336
SHAPES 575

HULL 87

DATE	TOTAL RCD. BY YARD FROM MILLS PLATES	TOTAL RCD. BY YARD FROM MILLS SHAPES & BARS	TONNAGE RCD. BY FAB'R.	TONS FAB. BY YARD	FAB. TONS RCD. BY YARD	TONS ERECTED	STEEL ON HAND AT YARD FABRICATED	STEEL ON HAND AT YARD PLAIN MATERIAL PLATES	STEEL ON HAND AT YARD PLAIN MATERIAL SHAPES	STEEL EN ROUTE MILLS TO YARD	STEEL EN ROUTE MILLS TO FAB'R	STEEL EN ROUTE FAB'R. TO YARD	TONNAGE RCD. BY FABRICATOR PLATES	TONNAGE RCD. BY FABRICATOR SHAPES
3/30	309	23.0	132.7	none	none	none	none	30 9	23.0	none	18.0	none	824	50.3
4/6	50.9	33.0	177.8	none	15.0	80	7.0	50.9	33.0	28.0	39.8	20.0	112.5	65.3
4/13	67.0	50.0	248.4	3	35.0	31.0	7.0	67.0	47.0	19.0	50.0	none	167.8	80.6
4/20	103.0	50.0	516.3	8	139.0	128.0	19.0	95.0	43.0	39.3	80.0	98	380.1	136.2
4/27	183.0	80.0	709.0	31	237.0	253.0	2.0	162.0	70.0	40.0	93.1	152	493.0	216.0

Form F.—Weekly Report of Steel Situation Carried for Each Hull

To file the manifests so as to be readily accessible, heavy pasteboard folders were numbered one to nine and the manifests filed by the first figure of the car number; that is, car 5048 or 578601 or 50 would be in folder marked "5." It is not necessary to consider the car initial.

To know the progress of the yard and fabricator, a "Weekly Report of Steel Situation" (Form F) was carried for each hull. Information as to material in transit and received was obtained from the "Car Record" sheet, and material fabricated and directed was covered by daily reports from the yard and fabricator.

The methods covered in this series of articles may be developed to fit the requirements of any yard. They are in use now and have given very good service, and the use of graphs in conjunction with the schedules makes it a very complete though simple control.

Fig. 1.—Steel Construction and Wood Bulkhead of a Pier Recently Erected

Harbor Improvements at San Francisco

Extensive Enlargement of Piers—Large Bulkhead Warehouses—Railroad Connection with Piers—Developments in Islais Creek Section

BY CHARLES W. GEIGER

THE Board of State Harbor Commissioners have completed plans for the immediate construction of $2,000,000 (£410,000) worth of harbor improvements at San Francisco. When completed, these improvements, in conjunction with the improvements now under way, will greatly increase the capacity of the present wharf space and will relieve the seasonal freight congestion, which has troubled the shippers here for years.

At the present time there are 49 active piers, with a cargo area of 5,712,080 feet, which is equal to 131 acres. There is a total berthing space of 15 miles, capable of accommodating at one time 245 average size vessels coming into the port.

Since 1911 there have been constructed 26 piers with a total area for cargo of 2,799,394 square feet, or about 65 acres, having a berthing cargo space of 34,137 lineal feet, sufficient to accommodate at one time 105 vessels of average size now entering the port. In addition, the port, since 1911, has reconstructed ten of the old piers with cargo area of 817,211 square feet, with a total berthing space of 13,444 lineal feet, sufficient to accommodate 41 vessels. In addition to the foregoing work, there has been constructed, since 1911, bulkhead wharves of a total length of 9,465 lineal feet from 45 to 80 feet in width, or a total area of 523,480 square feet, also four new passenger ferry slips and two new freight ferry slips.

Even with all this space every foot of wharfage along the waterfront is now occupied, and steps are being taken to hasten the completion of all work now under way, and to start on the new work, because, unless sufficient facilities of all kinds are provided soon, the port may be swamped with commerce.

Fig. 2.—Type of Modern Pierhead Which Is Replacing the Older Construction

Several important moves have been made recently by the Harbor Commissioners in the development of the port facilities to meet adequately the after-war conditions.

First, new plans have been completed for the immediate construction of bulkhead warehouse construction providing a chain of double-decked warehouses. This will mean establishing at least six of these structures between piers on the harbor north of Channel street. Estimates by the Board show that this additional cargo building space will be equivalent to the area of three new standard wharves 200 by 800 feet.

The programme for bulkhead warehouses designated the bulkheads between 39 and 41, 33 and 35, and 26 and 28 as the first three that will be used for double-deck construction. These are intended particularly for foreign trade. They will be equipped with the most modern cargo handling devices on both decks. Added to this is the single-deck warehouse now under construction between piers 31 and 29. Other points on the front where space can be used without cutting off the required berthing for ships will be utilized.

A special study was made by the engineers of desirable locations of these warehouses to which can be stevedored cargoes direct from the ship and there stored at the convenience of the importer. An arrangement will be made for the handling of this freight so that both incoming and export shipments may be moved with greater facility and with relief to the dock area in storing it. The plan will be extended as rapidly as needs develop. This programme is in line with plans which are the outcome of recent studies of the conditions with relation to possible recurrence of the freight congestion of last winter, and the needs of the port as developing with the new business expected to follow the declaration of peace.

These plans comprehend the extension of the present seawall along the front between the piers. The average extension from the seawall line waterward to get this additional space for warehouses will run approximately 150 feet, with the space between the docks to be thus connected varying from 200 feet. The plan of extending the bulkheads to give the space close to the docks will work out to better advantage to the state as well as to the commerce of the port by not increasing port charges.

In connection with these warehouses, plans have been completed for the immediate construction of three warehouses for foreign cargo in the landward side of the waterfront, connected with the piers by the belt line and such electric cargo conveyors as may be necessary to handle business for this warehouse programme. These structures will be of reinforced concrete construction, absolutely fireproof. The first of these warehouses will probably be six stories in height. The first site selected for these warehouses is seawall No. 4, in close proximity to docks which are now in overseas commerce use. This is already tracked for belt line service and is convenient for the handling of electric conveyors as may be required. This lot has an area of 20,000 square feet. The second warehouse will be built on lot No. 13, having an area of 27,000 square feet, and the third will be built on seawall lot No. 23, having an area of 88,000 square feet.

Fig. 3.—Interior Construction of Pier Shed with Spacious Proportions

In order still further to bring the full area of the waterfront into use, the Board has let the first contract in a plan of pier extension, which will add hundreds of thousands of square feet to the cargo handling capacity of the port. The first extension is being made at pier 21, carrying that pier to the full length of 800 feet at the pierhead line. This work is a prelude to the further development of the piers to their full length, limited only by the United States Government pierhead line. Following immediately will be extensions of pier 25 from 600 to 800 feet, all north of the ferry. On the south side of the ferry, pier 20, the old United States Army transport dock, which was in service during the Spanish-American War, will be extended. This pier was the headquarters of the transport service to the Philippines, and it will be carried out 450 feet farther to the pierhead line, doubling its capacity for berthing and cargo uses. The Board carefully surveyed the piers, with a view of determining those that should be extended. The piers that will not be increased in area are such as have been determined upon as requiring replacement in a few years with more modern construction. The policy is to construct piers of fireproof material.

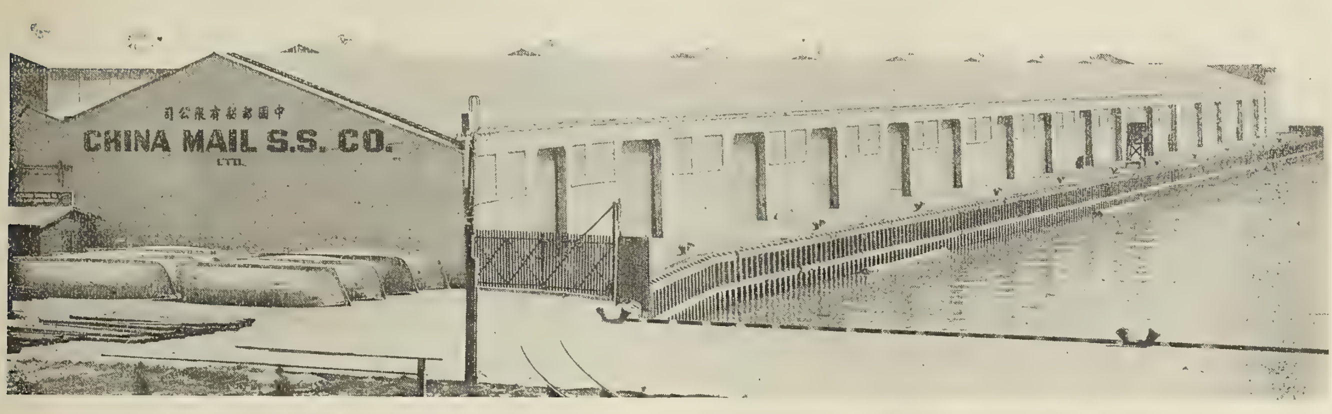


Fig. 4.—View of Modern Pier Showing Side Track and Frequency of Doors Opening into Shed

Pier 43 will be extended and widened to provide an additional 44,600 square feet of space for handling bulk cargo that can be loaded or discharged conveniently and economically without shed covering. The extension will be of irregular shape, ranging from 60 feet at the end of the present structure to 176 feet in width at its farthest projection in the bay.

Included in the plans for still further development is a project for a huge pier to replace No. 1, directly north of the ferry building. This pier will be erected immediately and will be used jointly by the California Transportation Company and the California Navigation and Improvement Company. Pier 1 will be 600 feet long, 138 feet wide and covered with fireproof shed, which will be supported by a reinforced concrete substructure and will constitute a second unit of the twin river steamer terminal. The pier will cost about $250,000 (£51,250) and the shed $150,000 (£30,700).

The plans for the construction work for all the contemplated improvements enumerated are in readiness, and the Harbor Board is taking steps to commence work at once, as the modifications of the building restrictions have removed the last barrier.

Reduction at the port of the cost of operation of cargo ships from the Orient and the cutting of the time in port for the loading and discharging of ships from an average of six days to four days on a round trip voyage—thus eliminating the geographical advantage of the northern ports with Asiatic ports, as against San Francisco—are comprehended in the installation of modern cargo handling equipment on the harbor docks. This is soon to be carried out by the Harbor Board. It is calculated that so much quicker dispatch will be given to ships in both loading and unloading that the amount of time saved will more than offset the comparative disadvantage which now handicaps the port due to the shorter route out of Puget Sound to the Chinese and Japanese ports.

The floating equipment privately owned, which can be rented by shipowners in San Francisco Bay, consists of five 20-ton floating derricks, with booms from 90 to 100 feet in length, one 30-ton floating derrick with a 60-foot boom, two 50-ton floating derricks with 100-foot booms and one sheer leg derrick with a capacity of 100 tons.

The Harbor Commissioners are completing plans for building the best-equipped terminal on the Pacific Coast for handling Oriental vegetable oils. The increase of Oriental oil imports has become so great, that the plans for handling of this oil consist of a $200,000 (£41,000) terminal at Islais Creek, and a tank barge to handle bulk oils from vessels. For the latter purpose the Board has recently purchased the tank barge *Mohican*, at a cost of $25,000 (£5,125). The barge has been equipped with numerous small tanks capable of handling, in all, 750 tons, and also with heating and pumping appliances to transfer oils from steamers that cannot shift conveniently from one pier to another.

For this terminal the state will set aside five acres of filled-in ground and the wharf lying at the south side of Islais Creek channel, west of the Third street bridge, accessible to large as well as small vessels. There is 30 feet of water there now, but the channel can be developed to such depths as may be necessary to berth as large ships as may be required. The point selected is within reach of the transcontinental rail lines.

The terminal will be equipped with the most modern equipment for discharging, storing, loading and handling vegetable oils in bulk, cases and in barrels. The wharf is to be entirely covered by an open shed, and the surface of the pier covered with liquid-proof covering set at a pitch which will permit the oil to be drained off and saved. The facilities are to include pipe lines, heating apparatus, loading racks, pumps, dumping tables and a heating room. On the five-acre lot will be built at least two public tanks, which can be utilized by shippers not prepared to utilize private storage.

Certain areas of the five-acre lot will be set aside for

tankage, to be leased to private handlers of oils. These firms will build their own storage tanks, but use the equipment of the state in unloading from the ships into the storage tanks or cars.

When this terminal is completed it, combined with the various private plants in the bay, will provide for storage

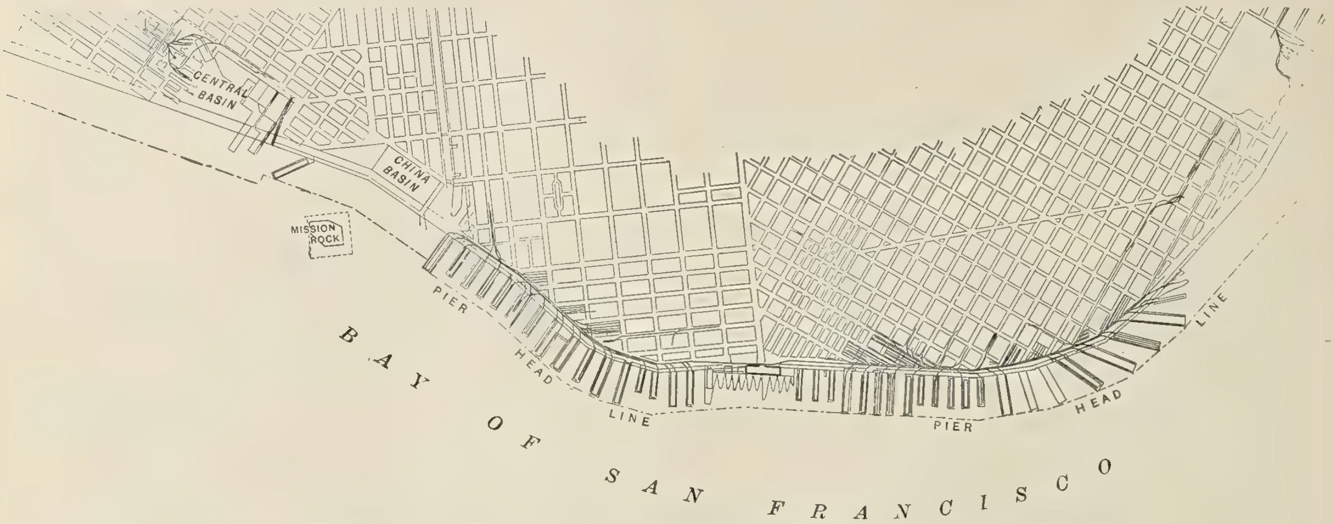


Fig. 5.—Plan of San Francisco Waterfront Showing Opportunities for New Developments

of nearly 50,000 tons. An oil terminal with a capacity of 8,000 tons was recently completed by the Philippine Oil Company, with an 8-inch pipe line leading to pier 38 for unloading oil from ships. This plant is now being extended, and when completed will have a capacity of 19,000 gallons.

What is probably the largest project ever contemplated by the Harbor Board is the development programme for Islais Creek and India Basin. The Southern Pacific, Western Pacific, Santa Fé and Ocean Shore railroads here come together at deep water in a manner not equaled anywhere in the state, and the advantages of this location could not be duplicated anywhere. This programme carries plans for the development of 160 acres or more of land, filled and submerged in the two basins comprehended in the joint treatment of the properties already in state possession and the small parcels of Islais Creek section yet to be acquired. There will be many miles of new dockage available to the port, as well as the establishment of a vast system of harbor facilities, which will provide for many years to come for the growing transpacific and domestic commerce of the port. As soon as the first units have been started, other units will be built which will involve improvements of the water and rail terminals extending from the channel to Hunter's Point.

The channel which forms the main entrance to the basins is now equipped fairly well to handle considerable business, but it will be brought up to its full capacity as fast as business warrants. The channel will be widened 50 feet on each side. This will be done first up to the Third street bridge, in connection with the projected wharf construction on the south side of the channel. West of the bridge the same width will be established for the handling of the shipping which will dock between the bridge and the Southern Pacific Railroad trestle. At the present time a new wharf extends along the south side of the Islais Creek channel from the Third street bridge to the Southern Pacific trestle, a distance of about 1,600

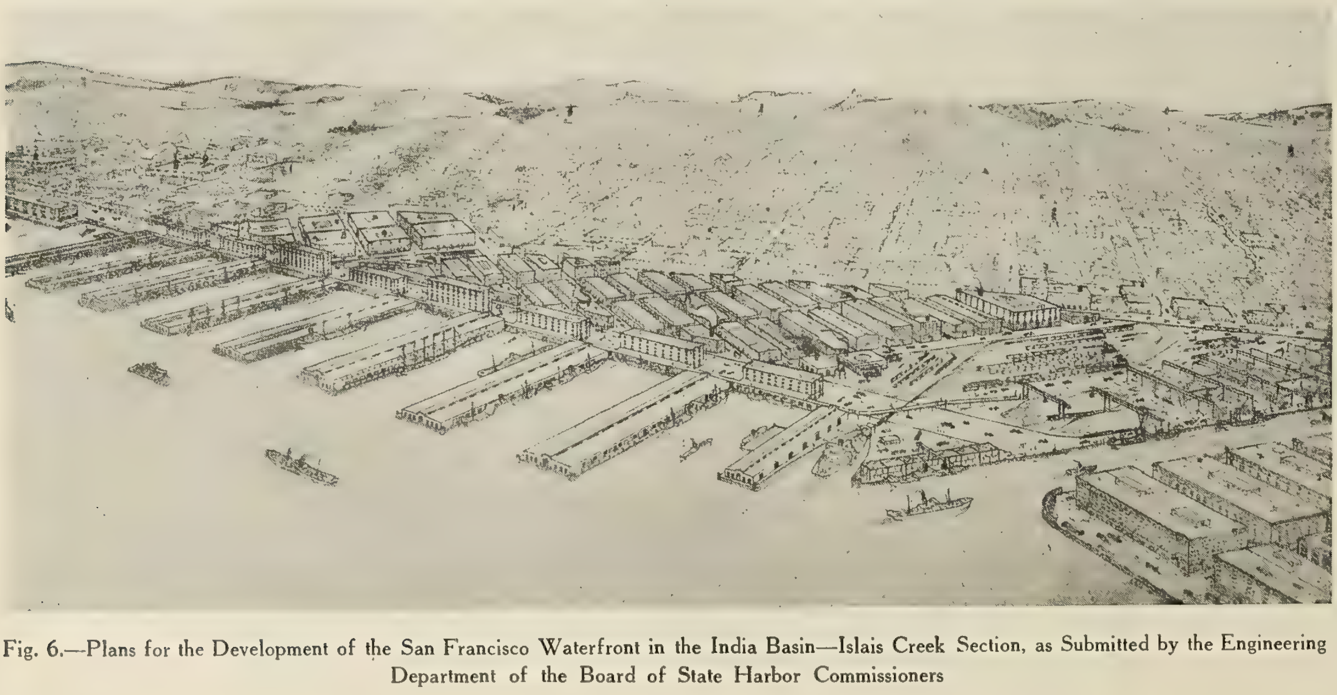


Fig. 6.—Plans for the Development of the San Francisco Waterfront in the India Basin—Islais Creek Section, as Submitted by the Engineering Department of the Board of State Harbor Commissioners

feet. A turning basin will be constructed in the channel west of the Third street bridge for use of smaller steam schooners and the craft which are using that part of the channel wharves.

On the south side of the channel, from the Third street bridge east, the 700-foot wharf, now completed, will be extended to 2,200, and later to 3,000 feet. From the outer end of this wharf a bulkhead will extend southerly, as seen in the architect's drawing, Fig. 6. Numerous piers, sheds and warehouses will be built. The slips will be 350 feet wide and ships of this length or less can unload directly into the sheds built on the bulkheads between the piers. The cargo can then be transferred directly to the warehouses seen just in front of these sheds, also extending between the piers. These will be connected with the railroads, bringing ships and rail together in a most efficient manner. In front of the warehouses will be built sidewalks and a street.

Included in these plans are coal bunkers for loading ships, and large docks for taking care of structural steel, coal, lumber, etc. These will be equipped with the latest equipment for handling the cargo.

The Harbor Board is unanimous in its opinion that the natural industrial growth is to the south. A great area in the basins will provide room for industrial expansion. A large rice mill was recently constructed west of the Third street bridge, and cargo conveyors are being installed, with facilities for docking cargo vessels in the channel. The site which will be utilized for industrial purposes is shown in Fig. 6.

The Board proposes to keep ahead of the demand and to anticipate the increasing call for harbor and industrial space. The general programme of development will be followed along progressive lines now being worked out by the engineers. When the piers now under construction north of Channel street are completed, all available space where piers could be constructed north of Channel street will have been exhausted, and new construction must be confined at Islais Channel, India Basin and China Basin.

Maintenance and Repairs

Coincident with the large increase in the harbor facilities and in the tonnage handled, the work of maintaining the property under the jurisdiction of the Board of Harbor Commissioners has also very largely increased. An efficient maintenance and repair department has been constantly at work, and all structures have been kept in good operating condition. While most of the work was done by the maintenance and repair department, some of the larger jobs were done by contract.

The development and extension of the State Belt Railway switching system have kept pace with pier development, and San Francisco undoubtedly now has one of the most complete harbor belt line railroad switching systems in the country, there being approximately 40 miles. The railroad is located on The Embarcadero, a marginal thoroughfare 200 feet wide, located just behind the seawall, and the system is intended and is used to connect up the various piers, the yards of other railroads and private warehouses and industries generally.

It has been the policy of the Harbor Board not only to equip all new piers with spur tracks running the full length of the piers, but also, wherever the water slip spaces beside the old piers were sufficiently wide to permit of it, to widen existing piers and place spur tracks thereon. Where there are tracks on both sides of the pier, the usual practice is to make one a surface track, and the other is depressed so as to bring the floor of the railroad car on a level with the floor of the pier, thus facilitating trucking of certain classes of freight. The practice is to accommodate the proposed tenants in this regard according to their preferences.

It was a practice of former years to install railway spurs down the center of the pier. But experience has demonstrated that the center arrangement is a mistake, because it interferes very seriously with teaming and trucking. The placing of the tracks along the sides of the piers, outside the sheds, is now universally demanded by shippers. This arrangement has been followed in all recent constructions.

Belt Line Facilitates Freight Movement

By recent construction and extensions, a continuous belt railroad switching system, adequately equipped, is now in full and successful operation around the whole active harbor front of San Francisco, from the Presidio on the north and west to Channel street on the south. It is a tremendous gain to the harbor, and its real advantages only become properly estimated when it is recollected that even such a great seaport as New York has no harbor belt line.

Street improvements upon The Embarcadero and other neighboring streets under the Board's jurisdiction have also been vigorously prosecuted. All the expense of constructing, maintaining, cleaning and lighting the harbor marginal street comes on the Harbor Board. To assist in policing and patrolling, flood lights and projectors have been installed at advantageous points so as to light the sides and ends of piers. The efficiency of the electrical department in safeguarding the waterfront against disastrous fires has been increased by the appointment of an experienced fire marshal and by the installation of fire-fighting apparatus.

For the purpose of obtaining data on the construction and operation of harbors, the Harbor Board sent Frank G. White, chief engineer for the Board, on an inspection trip to the principal ports of the United States and Canada. He visited the most important ports on the Pacific and Atlantic coasts, as well as on the Great Lakes and the Gulf of Mexico, and obtained many new ideas now being used in the operation of San Francisco Harbor.

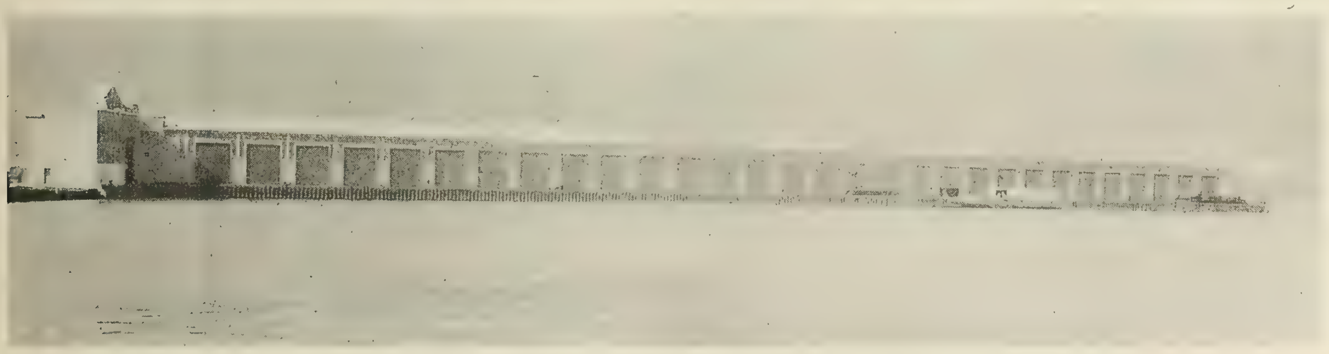


Fig. 7.—View of Long Pier Recently Built Which Incorporates the Newer Ideas on Pier Construction

Design and Construction of Producer Gas Power Lighter

Special Central Control for Engine and Hoisting Apparatus—Double Rudder Installation—Compact Engine Room Planning

BY FREDERIC S. NOCK*

THE plans are those of a power lighter designed and built by Frederic S. Nock, East Greenwich, R. I., for James A. Potter & Company, of Providence. This craft was built to carry lumber in Narragansett Bay and was developed along lines that were considered most practicable for the purpose. The question of draft was a prime factor, as was also the ability to carry a maximum load at a given speed. The lighter is installed with two gasoline engines, each of 50 horsepower, and a Galusha marine gas producer burning Chinese anthracite. When

Fig. 1.—Producer Gas Power Lighter Designed to Carry Lumber

it is required to operate the hoister, upon arrival of the lighter at destination, one engine is stopped, the clutch between the other engine and its propeller wheel disengaged, and another clutch in front of this engine thrown in. This connects the propelling engine to the hoister, with both engine and hoister controlled and operated from the pilot house. The drive from the starboard engine to the hoister is by means of bevel gears.

On the main line of shaft there is a sprocket operating a winch on the starboard side of the pilot house for handling the vangs of the boom, etc. The hoisting of the boom and handling of deck loads is done through controls operated in the pilot house. Pilot house control is also provided for handling main engines when the lighter is under way.

The hoisting apparatus was made by the Coulter & MacKenzie Machine Company, Bridgeport, Conn. The gas producer is placed in aft of the engines. The producer room is separated from the engine room by a bulkhead, and access to this is accomplished through two sliding doors.

Ample room is provided over the producer for the attendant to poke down the coal, etc. The engine room is large and well ventilated and contains, besides the propelling units and hoisting apparatus, auxiliary pumps and a direct connected generating set for electric lights. Ample ventilation and light have been provided for all rooms. Partitions between the producer and the engine rooms, as well as the living quarters, are double, with roofing papers between the two thicknesses.

TIMBER AND SCANTLINGS FOR 70-FOOT LIGHTER

Bilge logs	6 inches by 8 inches
Rake timbers	6 inches by 8 inches
Deadwood	Sided 6 inches
Frames	4 inches by 12 inches
Clamps	4 inches by 12 inches
Keelsons	6 inches by 8 inches
Deck beams	3 inches by 8 inches
Heavy deck beams	6 inches by 8 inches
Bulkheads	3 inches
Planking	3 inches
Deck planking	3 inches
Bumpers	10 inches by 12 inches
Bumper backing pieces	10 inches by 14 inches
Bitts	10 inches by 10 inches
Braces and diagonals	4 inches by 8 inches
Fenders	4 inches by 8 inches
Knees and quarter braces	8 inches thick
Spikes	⅜-inch by 7 inches and ⅜-inch by 8 inches
Edge bolts and fastenings	¾-inch diameter iron rod

The space over the engine room offers living quarters for the engineer and captain. It comprises two berths on the starboard side, a large clothespress, a toilet at the after end of the port side, lockers, dresser, shipmate range, table, sink, etc.

Owing to the amount of dead water carried at the stern of this type of self-propelled lighter, double rudders are used instead of a single rudder amidship. These, operating in live water, have proven much more efficient than the other design.

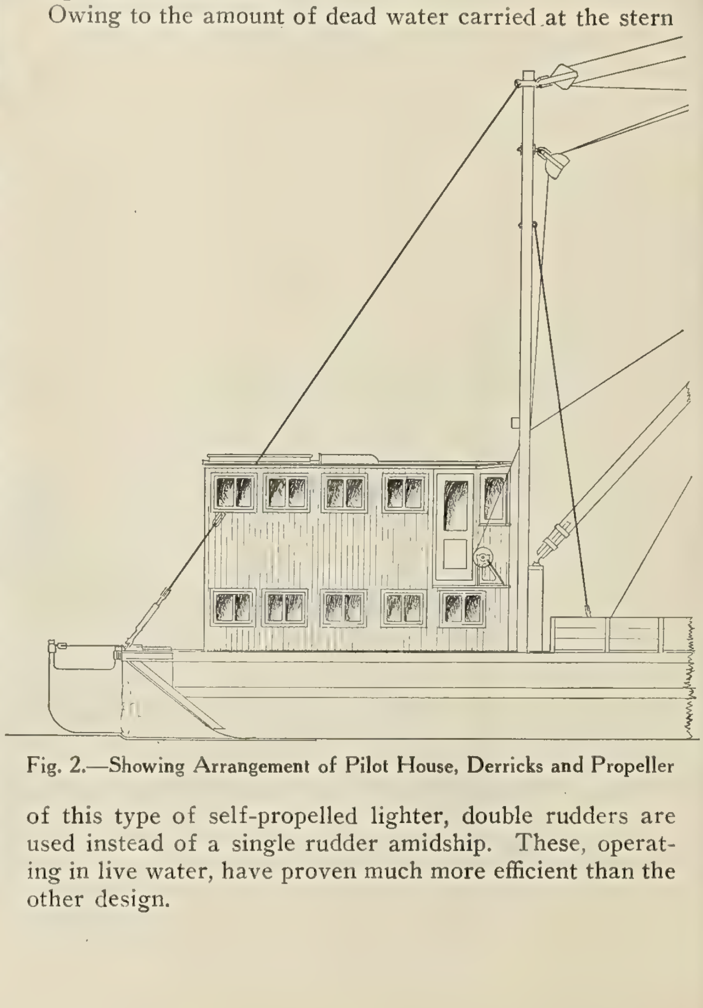


Fig. 2.—Showing Arrangement of Pilot House, Derricks and Propeller

* Naval Architect, East Greenwich, R. I.

While the "A" frame and boom were not required to raise heavy loads, ample provision has been made to secure a high factor of safety. The after guys of the "A" frame are 1-inch diameter crucible steel wire rope, and the forward guys ¾-inch diameter. The iron work for the "A" frame and boom is also of ample dimensions. The plans show the boom rigged with double pawl hoist, but for ordinary work in loading a single line will be used. This will expedite the handling of the deck load.

Heavy Carrying Capacity

The lighter has carried a deck load of 120,000 feet of yellow pine to the forts in the lower bay. Which will give some idea of the carrying capacity of the 70-foot lighter of this type.

The operating cost of this lighter is small, since the engineers for the hoister and the lighter crew also attend to the propelling machinery. The 100-horsepower plant, running full power for 10 hours, consumes but one-half ton of coal, costing about $5. A steam plant doing this same work would require two and one-half to three tons of coal, costing $25. To run the same engines on gasoline would mean using 130 gallons, costing about $35. Investigation shows that the first cost, fuel cost and also the upkeep cost of fuel oil engines would be much higher.

Palmer Brothers Engine Company, of Cos Cob, Conn., furnished the two 50-60 horsepower engines, each of which has four cylinder 7½-inch bore by 10-inch stroke, turning from 300 to 400 revolutions a minute. The 100-horsepower Galusha Marine Gas Producer was built by the Nelson Blower & Furnace Company, of Boston, Mass.

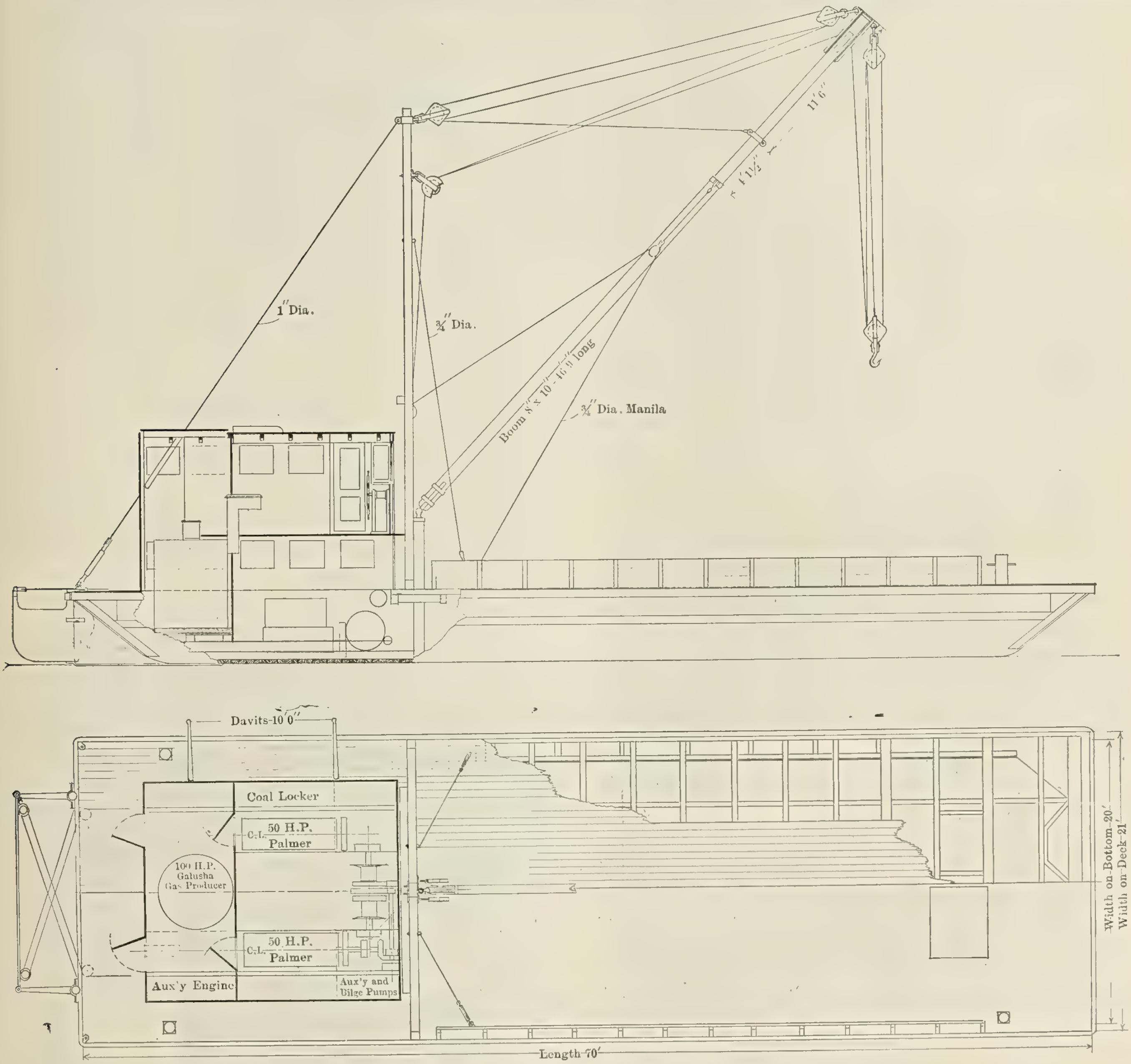


Fig. 3.—Profile and Plan Showing Engine Installation

General Dimensions and Construction

Length overall	70 feet
Breadth at deck	21 feet
Breadth at bottom	20 feet
Depth, bottom to upper side of deck	5 feet 2 inches
Depth of hold	4 feet

This lighter was put into active commercial use in September, 1918, and is used to transport lumber to Newport, R. I., from the Providence, R. I., plant of James A. Potter & Company.

Fig. 1.—Training Department (Director and Instructors) of the Submarine Boat Corporation

Training Workers for the Shipyards†

Short Cut Over Old Apprentice System—Work Progresses from Simple to Difficult Operations—Rivet Records Show Results

BY R. V. RICKORD*

THE education and training section of the Emergency Fleet Corporation, known in its embryonic stages as the industrial training department, has been in operation for twelve months. The work of the section consists partly in placing at the disposal of the various shipyards facilities to enable them to do a systematic and thorough job in the training of shipyard mechanics, and partly in conducting other features, such as the distribution of electric welding information and the training of men for the higher marine engineering positions. The policy adopted by the Emergency Fleet Corporation in the matter of trade training has led to the creation of a new trade in the shipyards, namely, that of instructor, and one of the first jobs which presented itself was that of supplying a basis on which to build up this new trade.

Fig. 2.—Learner Doing an Easy Snap Job on the "Farm"

When the Emergency Fleet Corporation was quite young, Admiral Bowles foresaw the difficulty connected with the breaking in of new men and the danger lurking in any promiscuous or old-time scheme, such as that in not only taking an unduly long time to make the required mechanics but also in turning them out in "half-baked" condition. While the shipyards were following up the scheme of breaking in men by placing them on the vessels as helpers, the study of how most efficiently to teach men trades had been going on for years by various interested authorities in institutional, municipal and university undertakings. It was from men of this type that Admiral Bowles sought advice and help. The result was the creation of a staff of expert trade teachers, each one of whom

Fig. 3.—A Job in the Air to Enable Learner to Acquire "Nerve" for Driving at Great Heights

* With Education and Training Section, Emergency Fleet Corporation.
† Photographs by Publishers' Photo Service.

Fig. 4.—The Next Job in Order of Difficulty

was an expert tradesman as well as an expert teacher, and whose job it was to convert an expert shipyard tradesman into a man of his own type, so that the tradesman could break in new men with a thorough working knowledge of the trade in the shortest possible space of time.

A definite scheme of study for prospective instructors was hit upon. Each instructor has had to go through the "dope," as the shipyard men popularly call it. No one has been certified as being qualified for the work of instructor unless he has satisfied the Emergency Fleet Corporation that he can handle a group of green men and instruct them properly.

Fig. 5.—Learner Doing Advance Work of Flush-Riveting on Vessel

After a year's efforts a large proportion of shipbuilders all over the country have, with the co-operation of the Emergency Fleet Corporation, installed Training Departments, and in District No. 2, with which this article mostly deals, almost 100 percent have recognized the superiority of the new method by installing the training departments recommended by the corporation. The figures showing the number of instructors trained and in training by the Emergency Fleet Corporation for the various steel yards in the district are as follows: Bayles, 9; Downey, 30; Federal, 22; Newburgh, 20; Standard, 10; Staten Island, 9; Submarine, 120.

No difficulty has been experienced in holding the tradesman's interest in the new undertaking. It may, indeed, be said that his efforts along instructional lines are quite extraordinary. He is called upon to make very extensive efforts during his six weeks' training period in learning how best to teach his trade, and this has the effect of so arranging the various details and aspects of the trade in his mind that the yard training department has frequently found itself face to face with the fact that no sooner has he been trained as an instructor than he has immediately been pressed into service as a foreman.

Fig. 6.—Learner Finishes by Doing Most Exacting Work That Can Be Expected of Him

As soon as the embryo instructor begins to analyze his trade for instructional purposes, he sees it in an altogether new light, and the new purpose becomes magnified. He picks out a series of representative jobs and gives these to the learner, being sure that the learner has thoroughly learned one representative job in the trade before proceeding to the next. In other words, a smoothness of progression is obtained by starting the learner with the easiest job and proceeding gradually with the harder jobs until the most difficult job that he can be expected to do is given him.

The riveting jobs shown in the illustrations serve to explain this. Beginning with Fig. 2, the learner is shown doing the easiest kind of snap-head riveting on the "farm"; then the same kind of work on a vessel in an easy position; then doing a somewhat more difficult job—flush-

riveting on the deck of a vessel—and after this, higher and more difficult positions, until, later, the more exacting flush-riveting work, and finally doing what is probably the most particular work on the ship that can be expected of him, namely, flush riveting on the shell of the vessel. The instructor is with the learner most of the time and follows him through all these jobs while in training, and in doing this can break in from four to ten new men at a time. All the work of training is done on the vessels or in the shops, so that every effort counts towards the completion of the ship, although the primary object of the instructor is not to produce ships but to produce new tradesmen.

Fig. 7.—Installing Machinery

The remarkable records accomplished by men who have come from the training departments of the various shipyards only one to three months previously are probably due to the thoroughness with which all the steps in the trade are taught. The most difficult job a man can do is comprised of the many minor jobs he has done previously, so that having learned the previous jobs thoroughly he finds no difficulty in doing the many small jobs which make up the big one. The riveting records of a few men from one yard taken at random will be of interest. The trades given are the former trades of the men and the records are those per day of ten hours. The yard had a riveting average of about 300 rivets per gang per day, and the men's records, after the men had been transferred from the training department to the production department not longer than three months previously, were as follows:

RECORDS OF WORKMEN

Previous Trade or Business	Number of Rivets	Size of Rivets
Auto mechanic	440	7/8 flush rivets
Rock driller	1,808	3/4 " "
Cowpuncher	900	3/4 " "
Laborer	720	3/4 " "
Policeman	640	3/4 " "
Broker	650	3/4 " "
Holder-on	850	3/4 " "
Helper	950	3/4 " "

A study of the pictures given here of these men will serve to bring out the type of men desirable upon which to build the training. The training problem, and the finding of suitable men, touch upon the proposition of maintaining and even upbuilding the whole status and quality of workmanship of the shipyard worker. If new men are to be broken in at all, it is of the utmost importance, whether viewed from the standpoint of shipyard management, trade union, or individual worker, that the job be thoroughly and systematically done, otherwise the result would be a tendency to lower the standards of the various shipyard trades rather than to raise them. The training department in the shipyard, as organized by the Emergency Fleet Corporation, takes upon itself not only the work of training the man, thus relieving the executives and foremen of the necessity of having to give the time, which most of them can ill spare, to the breaking in of new men, but it also undertakes the responsible task of turning a man over to production only when he can be placed on the job and trusted to do the work himself without having to be a source of constant anxiety to the foreman under whom he happens to be placed. Of course, there is an alternative. It is that if it is not possible to train an individual in the training department, by reason of his own inability, so that he cannot be turned over to the production department as a thoroughly trained individual, then it is to the best interest of everyone concerned to drop him.

The organization of a training department is such that one individual is responsible for all the training that is done in the yards. The job of this man is really that of "foreman of training," and he is responsible for the mak-

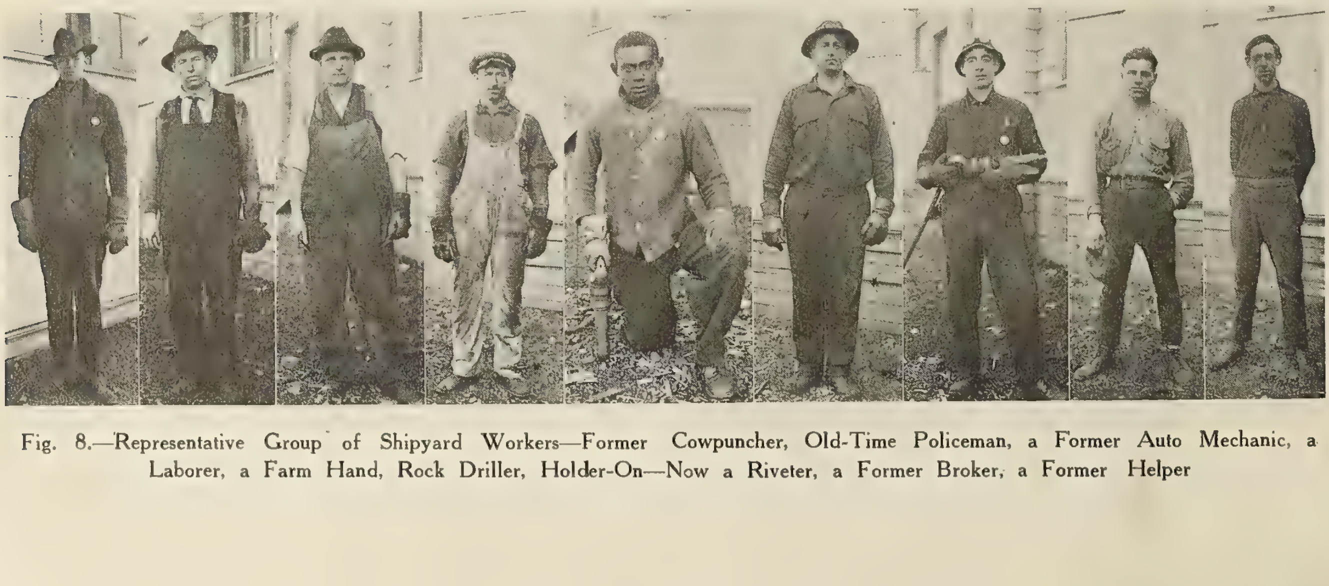


Fig. 8.—Representative Group of Shipyard Workers—Former Cowpuncher, Old-Time Policeman, a Former Auto Mechanic, a Laborer, a Farm Hand, Rock Driller, Holder-On—Now a Riveter, a Former Broker, a Former Helper

Fig. 9.—Calking

Fig. 10.—Bolting

ing of tradesmen out of "green" material. He works and co-operates with the various foremen in the yard, but not under them. He obtains from them all the work to be given to the men in training, and is responsible for the correctness and quality of the work. The separation of the training work from the ship work as ordinarily supervised by the foremen is due to the difference in the nature of the job. The men who do the training must have the opportunity to do their work without scampering through it, which is very difficult when done under pressure of the production department.

The ideal arrangement in the establishment of a training department is one in which the department "heads up" under a superintendent or manager who has sufficient sym-

Fig. 11.—Reaming

Fig. 12.—Heating

pathy for the movement, or desire for a proper trial, to bring about full co-operation between the training department and the production departments. This type of man obtains for the training department all the work on the ships and in the shops that may be necessary to enable the department to fully instruct all the learners it has on hand. Also he will give instructors sufficient time and encouragement to enable them to instruct the learners properly and in accordance with the arrangements laid out, and in which they have been introduced, by the Emergency Fleet Corporation. The placing of the training department under the proper individual superintendent or manager in the yard, in order that the proper co-operation and encouragement is obtained, probably has more to do with the successful working of a training department than any other item.

The importance of the yards now having systematic training arrangements can be gathered from the list given previously. The managements of some of these were openly doubtful when first approached on the subject as to the results. At the present time, however, not only have they expressed satisfaction, but in several cases have asked that a Fleet Corporation staff instructor be sent to their yard for the purpose of training more instructors to take care of the expansion in the training departments. Under the circumstances it is hardly necessary to make further statements as to whether the steel shipyards in the Emergency Fleet Corporation consider the training done with the co-operation of the Emergency Fleet Corporation to be more efficient and quicker than that done by the old method of placing the man in the yard as a helper and letting him pick up the trade as best he can, or by the apprenticeship method, which depends upon the personal willingness of the foreman or individual workman to show the man how to do the job, a system which tends to spread the process out over a period of several years.

Electric Welding in Ship Construction*

Methods of Welding and Apparatus Described—Inspection and Testing the Welds—Speed and Cost of Welding—Lloyd's Experiments

BY H. JASPER COX

TWO methods of electric welding are applicable to ship construction—resistance welding and arc welding.

Resistance welding may be applied in two ways—spot welding or butt welding. Spot welding has been extensively used for jointures of thin steel metal, such as ventilators, lifeboats and railway cars, with considerable success, but it is only recently that its application to thick plates and bars of the thickness required in ship construction has been investigated.

Spot Welding

The two or more pieces to be welded are overlapped or superposed in way of the joint and clamped between two copper electrodes; the current is passed through and pressure applied. In order to ensure a successful weld, the pressure should be sufficient to cause the metal to "flow" at the weld and to extrude all oxides, slag, etc., which may form. The pressure is maintained for a short time after the current is cut off, and the operation is then repeated at the next spot, and so on.

Small buttons or disks of metal are sometimes placed under one or both of the electrodes, and when of proper thickness are completely submerged in the plate metal during the operation of forming the weld.

As in smith welding, we cannot see what is going on at the welding surfaces, and, although the material may have been properly prepared, the success of the operation obviously depends upon:

(1) The amount of current applied to produce the proper heat throughout the various stages of the operation.

(2) A sufficient pressure to weld the surfaces and extrude oxides, gases, etc., without undue distortion of the material.

(3) Sufficient time being allowed.

(4) The size and type of electrodes used.

In light work these variables have to a great extent been determined by extensive practice and experience, but in the heavier material used in ship construction there has until recently been little or no experience available. However, the advantage of successful application of this method of uniting material to the exclusion of marking off, punching, reaming, countersinking and riveting in the fabrication shops and even on the ship itself are obvious. It is also patent that if the quantitative values of the above variables necessary to produce a perfect weld are definitely determined for all thicknesses of material, the operation becomes not only entirely mechanical but also uniformly efficient.

Intensive research work is now being conducted along these lines by the General Electric Company, who have built a heavy spot welding machine with a capacity of 100,000 amperes at 20 volts and a hydraulic pressure of 36 tons at the electrodes. A careful series of experiments is being carried out with this machine, using plates of from 1/4 inch to 3 inches total thickness, and it has already been demonstrated that satisfactory spot welds can be made within this range.

It has been found that an appreciable range is permissible in the variables of current, pressure and time without seriously impairing the efficiency of the weld for a given thickness of material. Where considerable *tensile* pull is anticipated in an overlap joint, it is considered desirable to have a double row of spots to prevent the tendency to bend and tear out the spots in the same manner as the countersunk heads of rivets are sometimes torn through the holes in a single-riveted overlap.

The 46-foot section of a 9,600-ton vessel to be built at the plant of the Federal Shipbuilding Company, Kearney, N. J., will be used to demonstrate the practicability or otherwise of this method of welding as applied to the assembly of material in ship construction. A stationary spot welder will be used in the fabrication of the parts, and a large 60-inch gap portable spot welder is being

* Paper read at the twenty-sixth general meeting of the Society of Naval Architects and Marine Engineers, Philadelphia, Pa., November 15, 1918.

completed which will be used both for clamping the parts together in the field and spot welding them in place.

It will be seen, therefore, that, although this method of welding has not yet reached the stage of development which might warrant its practical application to ship construction, it offers every prospect of doing so within the very near future. Obvious developments with this system are multiple spot and continuous or seam welding, both of which will tend towards great saving in time. In general, spot welding is much more rapid than arc welding and requires less labor, but more power and a much heavier and more expensive machine.

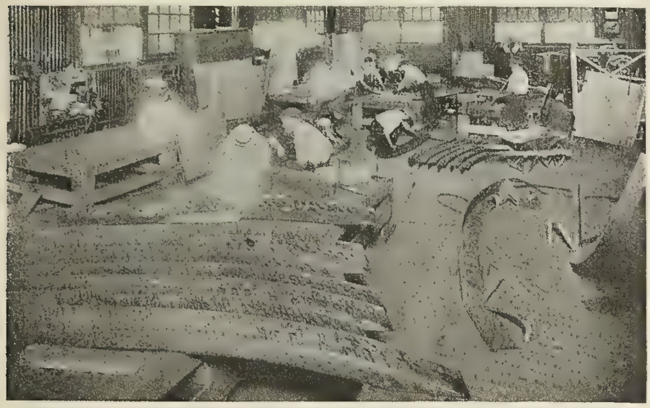


Fig. 1.—Electric Arc Welding Shop at the Submarine Boat Corporation Plant

Butt Welding

This system of resistance welding is especially applicable to bars of uniform section and will probably have a large future in jointing the reinforcements in ferro-concrete construction.

The bars to be welded are brought together, end on, clamped and a low pressure current passed through until a welding heat is obtained. Then end pressure is applied until the metal at the joint shows signs of squeezing out. A machine for this type of welding has been ordered by the Emergency Fleet Corporation and will be tried out during the construction of a 3,500-ton (deadweight) reinforced concrete steamer building by the Fougner Concrete Shipbuilding Company.

Electric Arc Welding

The two principal methods of applying electric arc welding are by means of: (a) the carbon arc; (b) the metallic arc. The main field of application of the carbon arc method is in rough cutting in foundries and steel mills and for the repair or building up of imperfect castings. It has not been advocated for use in ship construction generally, and there are a number of reasons which make it doubtful whether it ever will be. In metallic arc welding, however, a metal electrode is used of approximately similar material to that being welded, the electrode itself is fused by the arc, and molten particles are carried over the arc into the fused portion of the parent metal, thus gradually building up the joint. The actual operation, however, is not quite so simple as this sounds, as there are a large number of variables, any one or any combination of which may affect the efficiency of the result to a greater or less extent.

These variables may be enumerated as follows: (1) The type of electrode, *i.e.*, bare metal or covered; (2) chemical composition of the electrode; (3) chemical composition of metal being welded; (4) size of electrode; (5) kind of current, *i.e.*, alternating or direct; (6) amperage and voltage; (7) skill of the operator; (8) method of preparing and building up the joint.

In regard to the first, it may be said that good welds have been produced by either, but the covered electrodes have been found to produce, in general, a more ductile weld, a very desirable quality in ship construction. The chemical composition of the electrode is to-day considered to be a most important variable, and after an exhaustive series of tests the Welding Committee has drawn up the following tentative specification for electrodes intended to be used in welding mild steel of shipbuilding quality:

Chemical Composition.—Carbon, not over 0.18 percent; manganese, not over 0.55 percent; phosphorus, not over 0.05 percent; sulphur, not over 0.05 percent; silicon, not over 0.08 percent.

Sizes.—

Fraction of inch	Pounds per foot	Foot per pound	Pounds per 100 feet
1/8	.0416	24	4.16
5/32	.0651	15.35	6.51
3/16	.0937	10.66	9.37

Allowable tolerance .006 plus or minus.

Material.—The material from which the wire is manufactured shall be made by any approved process. Material made by puddling process not allowed.

Physical Properties.—Wire to be of uniform homogeneous structure, free from segregation, oxides, pipes, seams, etc., as proven by micro-photographs. This wire may or may not be covered.

Workmanship and Finish.—(a) Electric welding wire shall be of the quality and finish known as "Bright Hard" or "Soft Finish." "Black Annealed" or "Bright Annealed" wire shall not be supplied. (b) The surface shall be free from oil or grease.

Tests of Arc Welding

Tests.—The commercial weldability of these electrodes shall be determined by means of tests by an experienced operator, who shall demonstrate that the wire flows smoothly and evenly through the arc without any detrimental phenomena.

Further reference emphasizing the importance of this factor will be found later under the Rules of Lloyd's Register of Shipping.

Fig. 2.—Elimination of Angle Smith Work in Watertight Floor Boundary Angles

The chemical composition of the material to be welded is a quantity over which we have no great control, but open hearth mild steel of the quality under consideration

has generally sufficient uniformity in its chemical composition to permit a general application of the foregoing specification. However, the effects of varying carbon and other contents, including occluded gases, are being carefully investigated with a view to obtaining a more complete knowledge, and it is considered that a true understanding of the successful arc weld will result only from a combination of metallurgical and electrical study.

The size of the electrode in relation to the current

Fig. 3.—Misplaced Pipe Holes in Inner Bottom Plating Welded in 3½ Hours, Using 3 Pounds of Base Electrode

strength and the thickness of material to be joined is also a matter of obvious importance. While it has not yet been thought expedient to standardize these relations, the following table, published by the Quasi Arc Weltrode Company, may be found of interest:

Electrodes and Current Recuired for Sheet and Plate Welding

Thickness of work	Preparation of joint	Size of Electrode Inches	Current in Amperes
16 S. W. G.	Close joint	.08	20 to 25
14 S. W. G.	Close joint	.105	30 to 35
12 S. W. G.	Close joint	.105	40 to 45
10 S. W. G.	Close joint	.135	50 to 65
3–16″ plate	1–16″ open	.135	75 to 95
1–4″ plate	Veed half-way through and 1–32″ open	.16	93 to 110
5–16″ and 3–8″	Veed right through to 70° and 1–16″ open.		
	Two runs are necessary—		
	First run	.135	75 to 85
	Second run	.16	93 to 110
1–2″ plate	Veed right through to 60° and 1–8″ open.		
	Two runs are necessary—		
	First run	.135	75 to 85
	Second run	.192	100 to 120
5–8″ and 3–4″	Veed right through to 60° and 1–8″ open.		
	Three runs are necessary—		
	First run	.135	75 to 85
	Second run	.16	95 to 110
	Third run	.16	100 to 120

For heavy plates it is advisable to vee half way through from both sides if practicable. The current varies to some extent with the thickness of plate and type of electrode, bare electrodes requiring a higher amperage than covered. The kind of current, whether alternating or direct, has occasioned considerable controversy, and, while a direct current of a given open circuit voltage will permit of a slightly greater length of arc, the advocates of the alternating current claim that, since proper fusion depends upon the maintenance of a short arc, alternating current is preferable, as the arc itself will break if lengthened too much. As, however, efficient welds can be made by either, the question is more one of economy, ease of operation and convenience in the supply of current.

The amperage should be adjusted to suit the size and type of electrode and will be found to increase slightly with the thickness of material being welded; if too great for the size of electrode used, the fusion will not be uniform and steady, the electrode itself tending to "spatter," while if the amperage is too small, a proper fusion temperature will not be reached.

The voltage increases with the length of arc, and, in order to prevent this length becoming greater than is desirable for efficient welding, a number of machines and controls have been designed which automatically break the current if the arc is drawn out beyond the desired length. The range of length of arc usually adopted is from ⅛ to 3/16 inch, and the voltage varies from 15 to 25 with bare electrodes and from 30 to 40 with some types of covered electrodes.

The skill of the operator or human element is still the most vital factor. The density of current, and therefore the heat density of the arc, decreases as the length of the arc increases; a short arc, in general, results in a high temperature and virtual vaporization of the metal, while a long arc is apt to lead to the deposition of large drops or "beads" of electrode accompanied by oxidation. Consequently a varying length of arc naturally results in a lack of uniformity of the character of material in the weld. As, however, scientific investigation determines the effect of each of the above-mentioned variables, it will be possible to predetermine and specify with more exactness the ideal conditions under which a successful weld is assured, assuming that the arc is held at constant length. Until such time, we must remain largely dependent upon the skill of the operator, not only in maintaining the constant length of arc, but also in determining a most desirable current adjustment for the work in hand.

It may be interesting at this point to mention that automatic, self-feeding welding machines have already been designed and are now being experimented with. These machines will not only eliminate the factor of varying length of arc but will result in a considerable increase in speed of operation.

The preparation and building up of the joint have considerable bearing not only on the ultimate strength of the weld itself but on the time and cost of making it. Correct preparation of the joint for welding is just as important

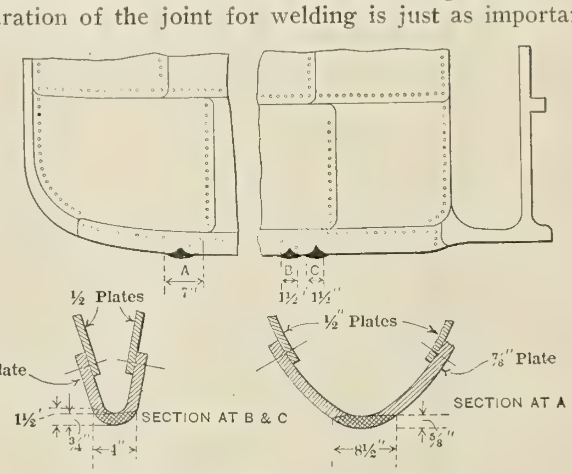


Fig. 4.—Repairs to Furnace Plates

if not more so, as in the case of a riveted joint. The time and cost of welding depends largely on the amount of electrode material deposited, and therefore the joint should be prepared so as to require the minimum amount of building up consistent with the necessary strength and accessibility. In large plates where a long joint, such as a seam, has to be welded, the contraction set up in cooling tends to draw the joint together, and unless proper pre-

cautions are taken the plates will tend to fold over one another at the end distant from that being welded.

Two methods to counteract this are generally adopted. In the "non-rigid" method the two plates, instead of being placed parallel with the joint, are diverged to the extent of about ⅛ inch to the lineal foot of weld; as the welding proceeds from one end, the plates gradually close together without setting up any great initial internal stresses. This method obviously introduces a number of practical difficulties if applied to the main construction of a vessel. In the "rigid" method the joint is tack welded at intervals along its length and the welding done, not continuously from end to end, but in separate stages, so as to distribute the heat as much as possible uniformly along the joint.

Welding Apparatus

The types of apparatus manufactured for electric arc welding may be divided into three main classes: (1) *Motor generator sets* operating from alternating current or direct current mains and designed to generate a suitable voltage. These machines are generally supplied with controls which automatically adjust the current to the length of arc operating. (2) *Stationary transformer sets* operating alternating current only. (3) *Resistance control.* This is the simplest of the three types and consists generally of a simple cast iron resistance grid which reduces the voltage from the main to that required at the arc, the difference being wasted. Where the main supply is over 110 volts, however, it is necessary to employ a motor generator set or rotary converter, or in the case of alternating current a static transformer, as the waste would be prohibitive.

It will be seen, therefore, that there is a great divergence in type, portability and, needless to say, in cost of apparatus advocated by the various manufacturers of arc welding outfits; and, since they all claim to make a satisfactory weld, it would appear that the question of selection devolves into one of economy of first cost, power efficiency, and portability. In this connection it is important to bear in mind that, while the simple resistance method is the least efficient electrically, its overall efficiency is increased, due to the current saving when the arc is broken, and in practice this probably represents about 50 percent of the total time.

The cost of wiring the shipway or shop is approximately the same with all systems. The average apparatus will work at about 6 to 8 killowatts per welder when welding, but if low voltage is provided at the mains, there are certain outfits which are said to reduce the consumption to as low as 3½ kilowatts, or even less.

Speed and Cost

Unfortunately, there are as yet very little reliable data of a general nature in regard to the speed and cost of welding on straight line work in the field. Again, there are so many varying factors which enter into the question, that any figures can only be considered with due regard to the particular conditions under which they were obtained. The following figures have been computed from some data obtained in England by Capt. James Caldwell, R. E., on

Metal Electrode Arc Welding (Quasi Arc)

Plate Thickness	Power used per foot run, amps. at 100 V.	K.W.H. at 3c	Electrode per foot run in cents	Labor at 65c per hour	Time per foot of weld	Speed in feet per hour	Total cost per foot of weld in cents
1-8"......	55 amps.	.54c	7.	2.165c	2m.	30	9.7
1-4"......	100 amps.	1.35c	12.9	2.954c	2m.45s.	22	12.2
3-8"......	100 amps.	4.8c	19.2	8.66c	8m.	7.5	32.66
1-2"......	120 amps.	7.2c	25.5	13.00c	12m.	5.	45.7

work done in the field during the construction of an all-welded barge recently built at Richborough. The figures have been adjusted to suit the present cost of welding labor and electrode material in this country, which differ considerably from those obtaining in England.

Other figures prepared by the Electric Welding Commit-

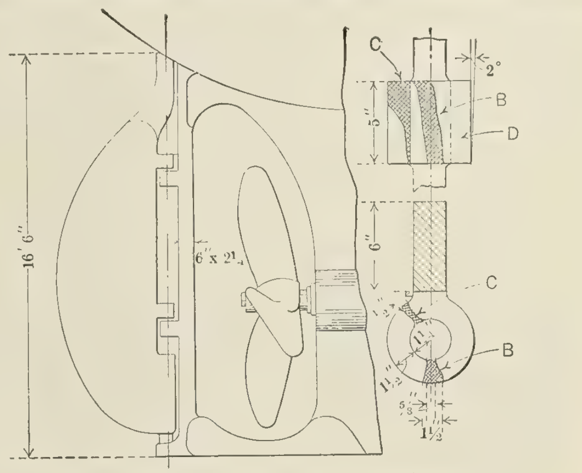


Fig. 5.—Repairs to Stern Post Gudgeon

tee show the possible cost of a fillet weld on a ½-inch plate, using a motor generator set and bare electrodes, to be as follows:

Average speed of welding on continuous straightaway work..........................	5 feet per hour
Amount of metal deposited per running foot.	.6 pound
Current 150 amperes at 20 volts = 3 kilowatts.	
Motor generator eft. 50 percent = 6 KW ÷ 5 equals.............	1.2 K.W.H. per 1-foot run
1.2 K.W.H. at 3 cents per K.W.H. equals	3.6 cents per foot
Cost of electrode 10 cents per pound, and allowing for waste ends, etc., equals...............	7.2 cents per foot
Labor at 65 cents per hour equals.	13.00 per foot
	23.8 per foot

We have seen that skilled workmanship is essential to good welding, and in the absence of any definite means

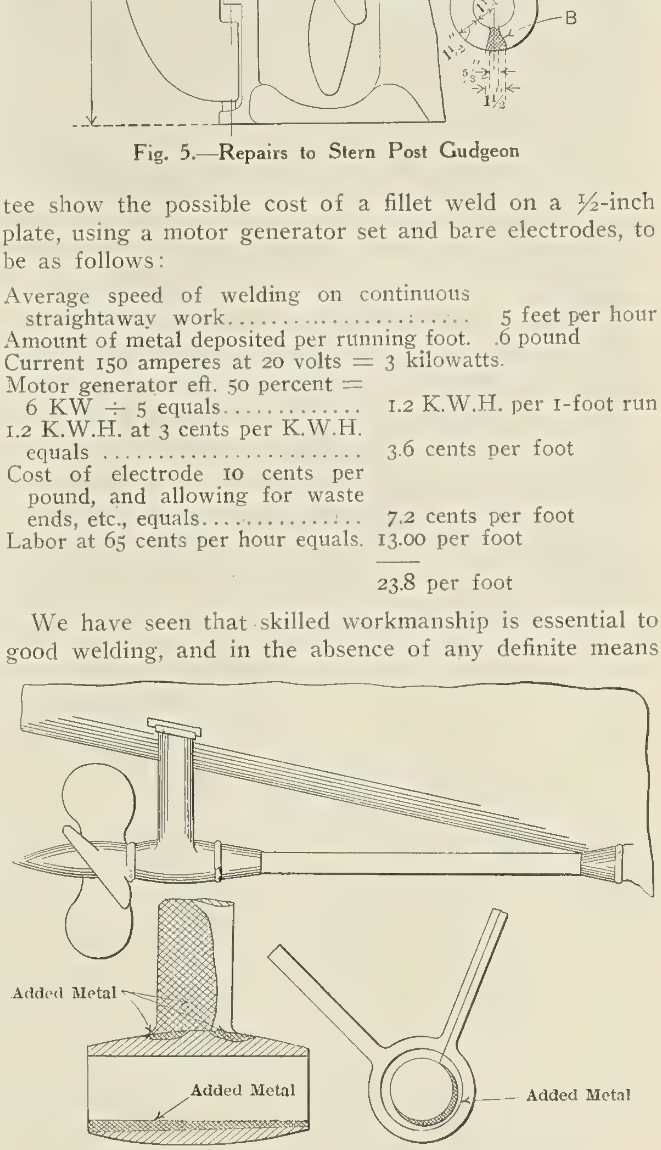


Fig. 6.—Reinforcement of Eroded Propeller Shaft

of testing finished work in the field, conscientious workmanship is equally important. A skilled and properly trained welder knows instantly whether or not he is making a good weld. He can tell this by the smoothness of the flow of metal, the uniformity of the sound and light of the arc, and by the lack of "spattering" or deposition of "beads."

The welder should possess some knowledge of the ele-

ments of electricity, how it is generated, conducted and controlled, the melting point of the metals employed, and the properties of the particular electrode in use. In ship work he should understand the correct methods of preparing the various joints and their relative importance, together with the best methods of building them up.

Inspection may be considered under three headings: (1) Inspection and testing of the electrodes being used; (2) inspection of the work before and during welding; (3) inspection of the completed welds.

We have already seen that the chemical composition and quality of the electrodes used have an important bearing on the quality of the weld produced, and care should be taken to see that only electrodes of the correct chemical compositions are used; that the wire is of proper size and of uniform homogeneous structure, free from segregation, oxides, pipes, seams, etc.; that the surface is clean, and that the wire flows smoothly and evenly through the arc without any detrimental phenomena.

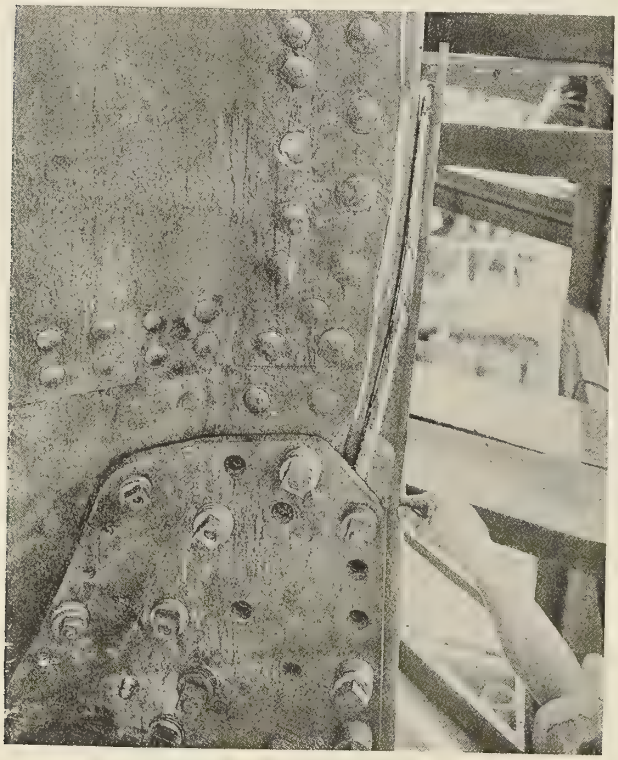


Fig. 7.—Attachment of Otter Extension to Stern

All work should be examined and approved before welding commences in order to see that the joints are properly prepared for the particular kind of weld to be made, that the edges are properly fitted or spaced and the work properly closed up.

In the thicker plates the first run of metal or "foundation" weld should be made with a small wire, carefully examined for flaws or defects and passed upon before the next layer of metal is added. This inspection should be carried out by specially trained supervisors, who should also watch the welding in operation, check up the current at the meters, and see that bad welds are cut out.

Various methods have been suggested for the inspection of completed welds, and the Research Committee of the Welding Committee is at present investigating a number of these, including electric resistance, magnetic, X-ray, and acoustic methods, but the problem is extremely difficult and has not yet shown indication of any solution.

In practice, the usual tests applied are by blows from a hammer or by chipping at intervals with a cold chisel or pneumatic tool. Either of these methods will usually detect a really poor weld approaching zero efficiency, but they cannot be relied upon to indicate the value of a joint, which, while not absolutely bad, does not reach the standard of efficiency required in a particular case. For this reason it is most necessary to rigidly test every material and system of welding proposed before accepting them as suitable for application to important strength members.

Present Application of Electric Arc Welding in Ship Repair Work and New Construction

The range of application of the arc welding process to the execution of marine repairs, such as the reclamation of broken castings, fractured plates, boiler furnaces and the reinforcement of eroded or badly wasted plate edges, and cracked hull plates is extremely varied. A few examples of non-structural work for which it is suggested that electric welding is specially adapted are the following:

Deck rail stanchions to plating; attachment of clips and hangers for pipes and wiring to casings, bulkheads, etc.; clips for attaching interior wood fittings to steel work; engine and boiler room stairs and gratings with their attachments; masts, derricks, ventilator cowls and trunking; cargo batten cleats to frames; hatch cleats to coamings; small tanks, bins and racks; skylights, generally; manufacture and attachment of storeroom, galley, and cabin fittings; welding studs in case armor plating for fitting of attachments.

Anglesmith work can be considerably reduced if the flanges of the angle bars are notched out, bent to the proper angle and electrically welded at the junction. The bending can generally be accomplished cold. Watertight or oiltight collars and the bosom pieces of watertight and oiltight boundary bars and bulkheads and double bottom floors can also be largely eliminated.

The saving in labor by welding some of the parts in the above list will average more than 60 percent.

Lloyd's Experiments on Electrically Welded Joints

A series of experimental tests was devised and carried out under the direction of Lloyd's technical staff in England, extending over a period of many months. The investigations were undertaken to determine the possibilities of the application of electric arc welding to shipbuilding, and, as it was desired to obtain as good a knowledge as possible of the physical properties of the combination of rolled and welded material, highly skilled operators were employed. The quasi arc process of electric arc welding was used throughout the experiments.

The general scope of the experiments included:

(a) Determination of modulus of elasticity and approximate elastic limit.

(b) Determination of ultimate strength and ultimate elongation.

(c) Application of alternating stresses with (1) rotating specimens, (2) stationary test pieces.

(d) Minor tests, such as (1) cold bending of welds, (2) impact tests of welded specimens.

(e) Chemical and microscopic analysis.

Tests were carried out on specimens as large as possible, particularly in respect to the static determinations of elasticity, ultimate strength and elongation, some of the test specimens being designed for a total load of just under 300 tons. The advantage of these large specimens was that the effect of workmanship was better averaged and the results were more comparable to the actual work likely to be met with in ship construction.

(To be continued.)

Standardization of Ship Steel

Less Diversity in Thickness Recommended—American List Provides Larger Number of Shapes with Fewer Thicknesses

TWO conferences of vital importance to shipbuilders and steel makers were held in Philadelphia on November 19 and 20, 1918. The first was a conference of steel makers to take action on modifications in rolls to produce ship channels and shipbuilding bulb angles, and the second was a conference between the steel makers and representatives of the Emergency Fleet Corporation to take action on a revision of the American standard practice and to recommend a selected list of structural shapes most suitable for ship construction.

Representatives were present at these conferences from all the larger mills which manufacture structural steel shapes—the Bethlehem Steel Company, Cambria Steel Company, Carnegie Steel Company, Eastern Steel Company, Illinois Steel Company, Inland Steel Company, Jones & Laughlin Steel Company, Lackawanna Steel Company, Phœnix Iron Company, Tennessee Coal, Iron & Railroad Company—and at the second conference the United States Shipping Board Emergency Fleet Corporation was represented by Fred T. Llewellyn, in charge of steel standardization, engineering section, division of steel ship construction, and by A. J. C. Robertson, chief designer.

Standardization of Ship Steel Begun Over a Year Ago

The first step in the direction of the standardization of ship steel was taken on July 2, 1917, when representatives of the above-mentioned companies, together with representatives of the manufacturers of plates, met in Washington and adopted the standard practice recommended by American steel makers, and subsequently adopted by the Emergency Fleet Corporation as a guide to the shipyards in placing orders with the mills for ship steel. The effect of the standard practice has been to eliminate minute variations in the thicknesses of plates ordered from the mills and to simplify the transmission of orders from the yards to the mills; and the situation as regards plates has been so greatly improved as compared with pre-existing practice that the plate mills have been able to make some remarkable production records.

At the time the standard practice was adopted it was deemed inadvisable to prepare a selected list of structural sections, but only to recommend that in general the use of sections rolled infrequently be eliminated and that orders be confined as far as possible to American standard beam sections, American standard structural channels and plain angles, provided, however, that ship channels and bulb angles might be rolled if required on shipbuilders' schedules. While it was recognized that the bulb angle and the ship channel were more suitable than any other sections for ship construction, the limitation in the use of ship channels and bulb angles was due to the lack of adequate facilities for their manufacture, and it was the desire of the steel makers to make as broad as possible the allocation of ship steel to all makers.

It was further considered unnecessary to draft a selected list of structural sections for the reason that it was believed the Emergency Fleet Corporation's plan for the standardization of the designs of hulls, particularly cargo vessels, would of itself operate to reduce the number of structural shapes required, and therefore no further action would be necessary. The recommended list, however, did limit the number of plain angles.

The experience of sixteen months has made it clear to American steel makers that the structural channel, by reason of its narrow flanges and steep inner flange slope, is not an entirely satisfactory section for use in hull construction; further, that the bulb angle is in very many respects a most desirable section for ship construction and that its use should be encouraged rather than discouraged, and, further, that the introduction of beams and structural channels into the list for ship steel had opened the way to the use of an enormous number of structural sections with relatively limited tonnages per section.

This situation had also come to the attention of the Emergency Fleet Corporation by reason of the difficulties which, due to the use of a great variety of sections, the shipyards had had in securing an adequate supply of all these sections in due sequence as required in construction. In consequence, an investigation was inaugurated in the Division of Steel Ship Construction, Daniel H. Cox, manager, with a view to the tabulation by tonnages, shapes and thicknesses of all the sections used at the yards, so as to make possible the compilation of a selected list of sections for use in the construction of ships on the basis of which it might be possible to insure the receipt of steel in adequate volume and due sequence, and also to arrange for warehouse stocks of suitable sizes at conveniently located points.

Diversity of Sections Used

This investigation, which was carried on by Mr. Llewellyn, covered 1,508 hulls of 10,302,150 deadweight tonnage either requisitioned or under construction by the Emergency Fleet Corporation, with a total shape weight of 1,100,651 net tons distributed among 131 different structural shapes in 403 thicknesses (sections). It was noted that in the case of one design for a 5,000-ton boat with but 1,026,966 pounds of structural shapes, there were 42 different shapes and 118 separate thicknesses (sections), of which nine sections were rolled only at one mill and one tee section only at another mill. Of separate sections there were items as low as 8 pounds each, and 35 sections less than 500 pounds each. Of one shape, only 43 pounds were required.

If such tonnage were the only tonnage available at the mills for this particular shape, it would require material for 4,600 boats to accumulate before considerations of economical production would justify placement of rolls. Of another relatively heavy shape on the same basis, economical production would require tonnage for 1,000 boats to accumulate. In the case of another cargo vessel of 9,400 tons, requiring 1,800,103 pounds of structural sections, there were only 16 separate shapes and but 44 thicknesses, and of each separate shape the minimum quantity of any one thickness was 2,800 pounds, and that of a section in very general use. The next smaller item on that list was three tons of a small angle section, which would only require material for 66 boats to accumulate. By the addition of 55 tons to the weight of the steel, the number of shapes in that particular boat might be reduced to 8 and the number of different sections to 19.

This investigation also indicated that, while a number of steel makers rolled bulb angles and ship channels, those sections represented the growth of years and reflected the individual ideas of the shipyards for which rolls were first

turned. There had been no definite endeavor to standardize these sections, with the consequence that American steel makers published different dimensions, weights and properties for sections of the same depth, the use of which at the yards should be interchangeable.

Conformation to British Standards Recommended

With the completion of his report and its distribution to the shipyards and to the steel makers, Mr. Llewellyn recommended that ship channels and shipbuilding bulb angle sections be adjusted to British standards, that steel makers confer and agree to publish like ranges of weights and dimensions, and that there be prepared for distribution to the yards a selected list of sections recommended as most suitable for ship construction.

The conferences were held in the offices of the Cambria Steel Company, with George E. Dix, assistant to the general manager of sales, in the chair. R. B. Woodworth, engineer with the Carnegie Steel Company, who had been instrumental in the formulation of the original standard practice, presented detailed written proposals as a basis of discussion for the modification and standardization of ship channels and bulb angles and for the revision of the American standard practice.

It was decided by the steel makers that inasmuch as the British standard sections of ship channels and shipbuilding bulb angles appeared to be better adapted to economical manufacture than the American standards, and inasmuch as the new rolls which had been turned in recent years to produce those sections conformed in general to British standards, hereafter American standards should be discontinued and rolls in hand not to British standards should be redressed at as early a date as possible to roll such sections as closely to British standards as slightly divergent methods of production would allow, particularly in view of the further fact that the adoption of British standard sections would enable American mills to compete on an even basis for ship steel wherever utilized in shipyards, either at home or overseas.

Three Bulb Angle Thicknesses Recommended

It was further agreed that in general ship channel rolls would be dressed so as to produce the Lloyd minimum and maximum thicknesses with one thickness .05 inch less than British standards, and that mills publish but one intermediate thickness in the Lloyd range of ship channels, and that in bulb angles in general where the Lloyd range seems to be too arbitrary and to provide an unnecessary number of thicknesses, the Lloyd range should be aimed at only in the deeper sections, that there should be but one thickness below British standards and that intermediate thicknesses be published to vary by .05 inches, bulb angles to show exact leg dimensions at British standards and at .10-inch intervals above.

Modifications in Standard Practice

Careful consideration was then given to a selected list of structural shapes to be recommended for ship construction, together with those modifications in the standard practice which the experience of sixteen months indicated to be desirable. These were further discussed at the second conference with representatives of the Emergency Fleet Corporation, and it was further recommended to the Emergency Fleet Corporation that as soon as possible a technical order be issued to all shipyards to put these recommendations into effect and that, so far as possible, orders for structural sections to be used in ship construction be governed by the recommended list of sections, as shown in the table.

STRUCTURAL SHAPES RECOMMENDED FOR SHIPS

Dimensions in Inches

Bulb Angle Weights Approximate

EQUAL LEG ANGLES

Size, Inches	Thickness, Inch	Weight per Foot, Pounds	Size, Inches	Thickness, Inch	Weight per Foot, Pounds
6 by 6	.750	28.7	3½ by 3½	.625	13.6
	.6875	26.5		.5625	12.4
	.625	24.2		.500	11.1
	.5625	21.9		.4375	9.8
	.500	19.6		.375	8.5
	.4375	17.2		.3125	7.2
	.375	14.9		.250	5.8
5 by 5	.750	23.6	3 by 3	.500	9.4
	.6875	21.8		.4375	8.3
	.625	20.0		.375	7.2
	.5625	18.1		.3125	6.1
	.500	16.2		.250	4.9
	.4375	14.3			
	.375	12.3	2½ by 2½	.375	5.9
				.3125	5.0
4 by 4	.750	18.5		.250	4.1
	.6875	17.1			
	.625	15.7	2 by 2	.250	3.19
	.5625	14.3		.1875	2.44
	.500	12.8			
	.4375	11.3			
	.375	9.8			

UNEQUAL LEG ANGLES

Size, Inches	Thickness, Inch	Weight per Foot, Pounds	Size, Inches	Thickness, Inch	Weight per Foot, Pounds
6 by 3½	.750	22.4	4 by 3	.500	11.1
	.6875	20.6		.4375	9.8
	.625	18.9		.375	8.5
	.5625	17.1		.3125	7.2
	.500	15.3			
	.4375	13.5	3½ by 3	.500	10.2
	.375	11.7		.4375	9.1
				.375	7.9
5 by 3	.500	12.8		.3125	6.6
	.4375	11.3		.250	5.4
	.375	9.8			
	.3125	8.2	3 by 2½	.375	6.6
				.3125	5.6
				250	4.5

BULB ANGLES

Size, Inches	Thickness of Longer Leg, Inch	Weight per Foot, Pounds	Size, Inches	Thickness of Longer Leg, Inch	Weight per Foot, Pounds
10 by 3½	.725	35.2	8 by 3½	.550	23.2
	.675	33.2		.500	21.6
	.625	31.1		.450	19.6
	.575	29.1		.400	18.0
	.525	26.9			
	.475	24.9	7 by 3½	.525	20.0
				.475	18.6
9 by 3½	.625	28.6		.425	16.8
	.575	26.6		.375	15.3
	.525	24.8			
	.475	22.7	6 by 3	.475	15.6
	.425	20.9		.425	14.1
				.376	12.8
				.350	12.2

SHIP CHANNELS

Size, Inches	Thickness, Inch	Weight per Foot, Pounds	Size, Inches	Thickness, Inch	Weight per Foot, Pounds
12 by 3½	.700	40.8	8 by 3½	.525	25.3
	.600	36.8		.425	22.6
	.500	32.7		.375	21.2
	.450	30.6			
			7 by 3½	.500	22.5
10 by 3½	.675	34.8		.400	20.1
	.575	31.4		.350	18.9
	.475	28.0			
	.425	26.3	6 by 3½	.475	19.8
	.375	24.6		.375	17.8
				.325	16.8
9 by 3½	.650	31.3			
	.550	28.3	6 by 3½	.350	15.2
	.450	25.2			
	.400	23.7			

TEES			HATCH ZEE (TYZACK)		
6½ by 6½	.450	19.8	2½	.500	13.6

15-INCH STRUCTURAL CHANNELS

Thickness, Inch	Weight per Foot, Pounds	Thickness, Inch	Weight per Foot, Pounds
.818	55	.524	40
.720	50	.426	35
.622	45	.400	33

27 Shapes—115 Sections

Sections not shown in the above list may be included on shipbuilders' schedules, with the proviso that they be specified only when they can be ordered in lots of not less than 40,000 lineal feet per shape at one time, or by special arrangement with the mills. Orders for such shapes should not be divided among mills, but the entire

quantity of each shape should be placed at one mill with the express stipulation that that mill may at its option roll, ship and invoice all the tonnage at one time regardless of its position in the shipyard and fabrication schedules.

The British Admiralty Standards

It is to be noted in this connection that the same problem of the standardization of ship steel has had the careful attention of the British Admiralty, the steel makers and the shipyards of England where the multiplicity of sections specified on shipyard schedules has also interfered with the progress of ship construction. In consequence, under the auspices of the Admiralty and the Ministry of Munitions, to facilitate regular and frequent rollings and thus avoid delays, a list of standardized sections has been drawn up and published in a pamphlet entitled, "Procedure for Obtaining Ship Steel, December, 1917." For cargo vessels (standard ships) this list includes but four sizes of angles—6 inches by 6 inches, 6 inches by 3½ inches, 3½ inches by 3½ inches, and 3½ inches by 2½ inches; three sizes of bulb angles—10 inches by 3½ inches, 9 inches by 3½ inches, and 8 inches by 3 inches, and but two sizes of ship channels, a 12-inch by 3½-inch light section and a 12-inch by 3½-inch heavy section. For Admiralty oilers (tankers) there are shown but four sizes of angles and six sizes of bulb angles.

While the number of shapes in the English list is much smaller than the number of shapes in the recommended American standard practice, English mills are accustomed to roll shapes with much narrower variations in thickness than American mills, and in view of the desirability of the widest possible growth of ship construction in the United States it is inadvisable too narrowly to restrict American shipyards. The American list provides a larger number of shapes with fewer thicknesses.

Reconstruction and Extension of American Merchant Marine*

THE creation of free ports, the construction of adequate warehousing facilities, and the adequate provisioning of our harbors with docks and machinery for the speedy loading and discharging of cargoes constitute possibly the most important factors which will secure for our country its rightful place in the world's international trade. Our wealth, our resources, our sound business reputation and our geographical position designate us to accomplish our great role in the coming work of reconstruction.

European countries will need grain, cotton, wool and raw material of all sorts. We will have to supply them not only with all our normal surplus, but also with the war products of Eastern Asia and South America. The colonial markets situated on our west and south will need millions of manufactured commodities of which they have been deprived during all these years of war, and capital to increase their productivity. We must try to supply them not only with our own products, but with those of our allies, whose energies should not be diverted by problems of shipping, but left free to concentrate on the production of goods, the export of which is necessary for the rehabilitation of their finances sorely in need of recuperation. For the same reason we will have to supply colonial markets with the capital they need to develop their natural resources.

Similar reasons have in the past made of Lubeck, Hamburg, Amsterdam, Antwerp, London and Liverpool the transshipment harbors and entrepôts of the world trade. As the axis of international trade has always traveled from east to west, it is permitted to presume that, with the development of the last years, it will soon touch our shores; but as in the past it has been proved that an enterprising nation, seeing a little ahead of time, can make the course of international trade deviate to its shores provided they are situated in the proper general direction, it will be up to us to attract and retain for many generations the international flow of commercial transactions between our terminals of the Atlantic and the Pacific. To do this we merely need to follow the example set forth by the enterprising Hanseatics, Dutch, Flemings and Englishmen.

The necessity of erecting adequate docks and machinery in our harbors is generally understood by all. Its details are, however, to be worked out by experts, and it should be left to the city and port authorities of every harbor to discuss the subject with their engineers. It would suffice that citizens of such ports took up the discussion through the ordinary channels with the competent authorities, so as to impress them with their desire of increasing port facilities in order to attract trade by giving efficient service. The construction of adequate warehousing facilities is a matter which can only be left to private initiative. Financiers and tradesmen of our big harbors should at once get together to discuss ways and means to create new warehouse companies and increase the capacities of the existing ones.

As for the creation of free ports in our key harbors, by this we mean ports situated along the international trade routes passing through the United States, this measure would require complicated negotiations between several interests and federal, state and port authorities. In fact, the aim of a free port is to afford transshipment and warehousing facilities for transient goods. To this effect, a certain part of the port is fenced off and set apart and all goods discharged and warehoused "in bond" in this segregated part are free of custom duties, as they are, in principle, destined to leave the country. In other words, they are receiving for shipping convenience the hospitality of a port before being shipped to their ultimate destination. It goes without saying that, should they have their destination changed and be sent outside the limits of the free port for consumption in the country which has offered them hospitality, they fall at once under the usual custom tariff.

The results obtained by the establishment of free port zones are at once apparent. Harbors which have had recourse to this system have become distribution points not only for their hinterlands, but for the international trade of the world. It goes without saying that if a producer in China, for instance, has shipping facilities to send his raw material to an American port on the Pacific where he knows that his goods will be stored free of custom duties until a purchaser offers himself, and that if European buyers in quest of Chinese raw material know that they can find it in an American Pacific port where they will have no other expenses than those of transshipment, which, through special arrangements with railroad lines and other shipping companies, can be held at a comparatively low scale, both the Chinese producers and the European merchants will transact their operations in the American port.

With good shipping facilities, warehouse accommodations and free zones, American harbors on both oceans would become the distribution points of the world's commerce and would secure for the United States not only all the advantage lawfully falling to the middleman, but also all those deriving from freight charges.

* From talk with Secretarial Department, Equitable Trust Company, of New York.

Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

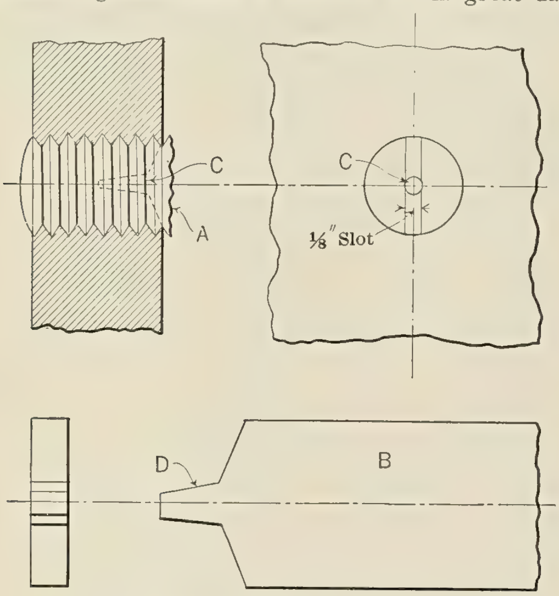
This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Device for Removing Broken Studs

During the last eighteen months or two years I worked in the engine room of a certain ship running on a certain ocean between certain ports. That seems to be about the current style of telling where you are and what you are doing.

During these voyages the ship has had to look out for and dodge "tin fish," as we call them. As this is accompanied with considerable danger, there has been trouble in getting crews, engine room and fire room forces.

Right here, Mr. Editor, I would like to say that, given a skipper as good as the one I sailed under, a ship that can make eighteen knots or more is not in great danger from "tin fish." If the United States Government puts afloat twelve-knot boats she is simply feeding these "tin fish" and will be making a grave error. But "that's another story," as Mr. Kipling says.



Tool Fitted to Remove Broken Studs

A nice-looking young fellow came down into the engine room while we were lying at a certain port. He said that he would like to go to sea—was a machinist and had built and run small engines. After a little talk we took him up to the shipping office and he was given an oiler's berth.

He wasn't seasick in the slightest. In two or three days he seemed perfectly at home and contented. We had on board a dense air ice machine. As the young man had never seen one of these he wanted to know why it wasn't working. The fact was that the lock nut on the compressor piston rod had become loose. It seems that the cotter pin had been carelessly left out when a set of new leathers had been put on the piston. Consequently, the back cylinder head was knocked off, carrying with it three studs, which broke off close to the cylinder castings. We had no time to replace these broken studs nor, in fact, did we have anyone able to tackle the job.

"I'll take them out," the young fellow said, "if you will give me a stud wrench." I asked him how he was going to get a wrench on a stud which was broken off flush with a casting. I had no such wrench. He seemed puzzled at first, but finally said, "I'll go 'upstairs' into the machine shop and make one, if you will let me. I can get out the studs in no time." In about an hour he came down with the improvised tool shown in the illustration. The material was a piece of ¾-inch round tool steel, *B*, 12 inches long; one end was squared for a wrench, the other was machined as shown, hardened and drawn to a deep straw color.

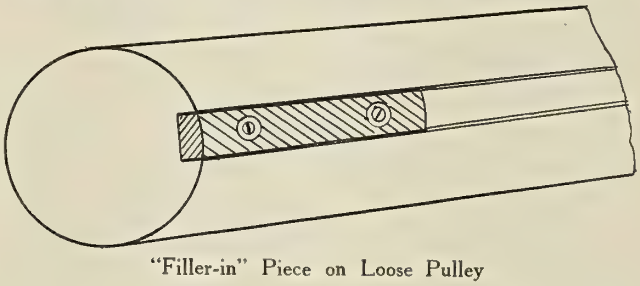
The young man drilled an eighth of an inch hole, *C*, in the center of each broken stud, *A*, with the electric breast drill. Then with a small cape chisel, which he got from the tool chest, he chipped from the outside edge of the stud two slots opposite each other, starting from the face of the casting and running at an angle down into the eighth-inch drilled hole. These slots were about ⅛-inch wide. The angle was about the same as the tit, *D*, turned on the end of the piece of tool steel. Putting the tool back into the stud, and the wrench on the squared end, the young man backed the broken stud out with as much ease as a whole one could be put in.

Now, Mr. Editor, the whole trick in this—and it is a good one—lies in the taper, as it is evident that it gives a great length of bearing which cannot be obtained by chipping a straight slot for an ordinary screw driver. It is, of course, evident that the little round tit on the end of the wrench or screw driver is not necessary. A piece of flat steel tapered off would act just as well—in fact, I know it would, as I have tried it.

Engineer.

Adapting Keyed Shafts for Loose Pulley

It frequently happens that shafting intended for a tight and loose pulley drive is keyseated its entire length. As a result, the loose pulley usually wears out and becomes wobbly in a short time because of the cutting effect of the sharp edges on the keyway. The best course is to order the shaft with the keyway where the loose pulley is to run. If, however, the keyway is encountered it can be readily fixed up by inserting a filler-in piece as shown in the accompanying sketch; the way is filled up with a piece of steel, fixed in place with countersunk screws and then emeried off until an even bearing surface is obtained. The time and trouble necessary to put in this filler is well compensated for by the increased life of the loose pulley and reduced friction loss.



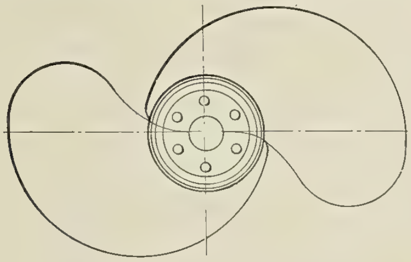
"Filler-in" Piece on Loose Pulley

Philadelphia, Pa. W. A. Lailer.

The Propeller

A great deal has recently been said and written concerning ship design, ship construction and the various parts of machinery in use in modern steamship installation. Seldom, however, is the propeller even mentioned, much less discussed, or improvements in its design suggested. Since John Ericsson made the propeller and put it into common use, the impression has been that it cannot be improved. Perhaps that is so. I have often wondered, however, why a serviceable propeller could not be constructed by using two loose blades, fitted into a hub made in two parts, and bolted together. If the blades were then made larger at the rear end, the propeller in action, would exert more force, since it would be pushing against the water steadily, instead of cutting it as does the three- or four-blade propeller. The illustrations show the details of such a design. I should appreciate the criticism of those interested in this idea.

Proposed New Type of Propeller



Shape of Two-Blade Propeller

Worcester, Mass. E. M. Peterson.

Place for Utilizing All Vessels and Training Crews

I have read with interest the article "Manning the New Merchant Marine." In addition to the details outlined, I would further suggest a signal plan for the training of officers and crews.

First, that the prospective marine officer send his application to the Sea Service Bureau with details as to his qualifications, former experience, actual service, if any, and branch of service in which he desires to enlist.

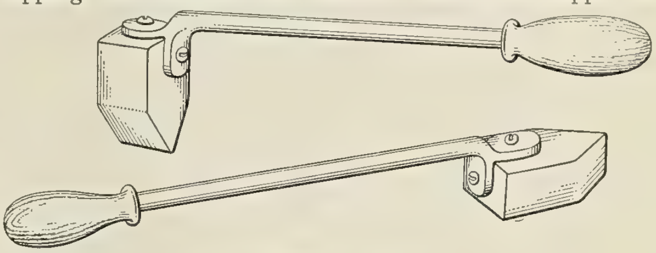
Second, on the basis of this information, if it be known that the applicant has seen actual sea service, but not as an officer, he should be enrolled in a special class, training him in the science of navigation or marine engineering until he passes a rigid examination as an officer. After this, he should be sent aboard ship, but not yet as an officer, to receive further instructions at the hands of competent commanding sea captains, or Government instructors provided especially for this training purpose. At the conclusion of this training a second examination should follow, when final license is granted the new officer.

In training crews for the merchant marine, I would suggest that the Shipping Board secure competent instructors and place them on board of ships, which are specially suited for training new men, in actual service of ocean commerce. Each of these ships should be provided with an instructor and a crew of from ten to fifteen men, these men to work in conjunction with the trained crew during specified watches, and separately under the supervision of an instructor until such a time as they can be readily inducted into the trained crew's service. Arrangements must be made so that one ship and instructor trains men for deck hands, and another for fireroom, engine room, or steward's branch, etc.

Stillwater, Minn. Otto Dorthen.

Handy Soldering Copper

By making a special type handle from round iron rod having one end split and formed L-shaped, drilling and tapping two holes in the side and end of the copper to match the holes in the handle feet, as shown in the sketches, the soldering copper is made more useful, as it can then be handily used on all sorts of work.

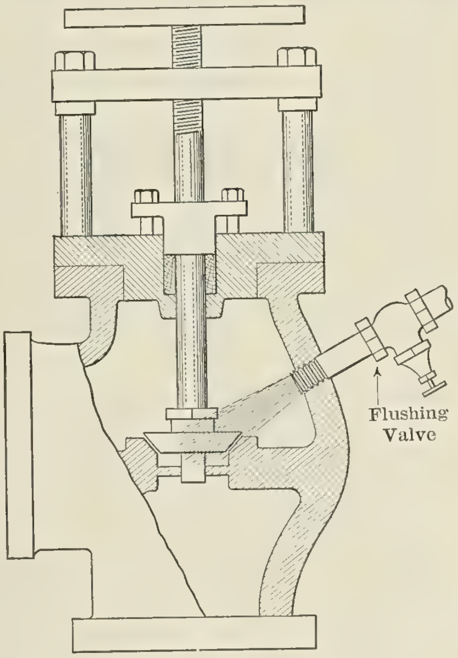


Handy Soldering Copper

C. H. W.

Flushing Valve Seat

The sketch shows how we cured the disagreeable trouble of a valve seat that always leaked, due to fouling. The valve was an outboard delivery valve of a bilge pump and auxiliary condenser discharge line. The bilge pump always managed to discharge enough fouling matter to prevent the proper seating of the valve, and when repairs were to be made on the pump line sea water almost always leaked.



Flushing Valve Seat

By putting in a ⅜-inch valve connection, as shown, and connecting it to a water pressure, this was used to flush the large valve seat each time the valve was closed. This eliminated the trouble. "Old Timer."

Cleaning Handhole Plates on Babcock & Wilcox Boilers

This subject is one that few engineers would perhaps think of writing about, yet it is one that is worthy of being given a share of attention. As the writer has had to handle a battery of sixteen Babcock & Wilcox boilers that called for cleaning of all tubes every month, he has tried in his own way to cut down the enormous amount of labor required, and in these notes and sketches he passes on a few homely ideas for others to improve upon.

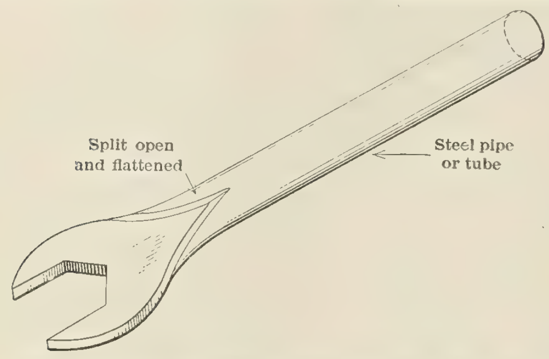


Fig. 1.—Light Skeleton Wrench Made from Pipe

In the work of cleaning thoroughly the tubes of one boiler of the 27-header type, there is involved the removal and cleaning of 581 handhole plates. Multiply this by the total number of boilers (16) in the plant, and we find there are 9,296 plates. Now there is a seat on the plate and one in each header, making two joint seats for each to clean. It can readily be seen that any devices or schemes that will aid in shortening the time needed to clean one plate will save much time and labor when multiplied into the whole operation, and that it will pay to adopt them.

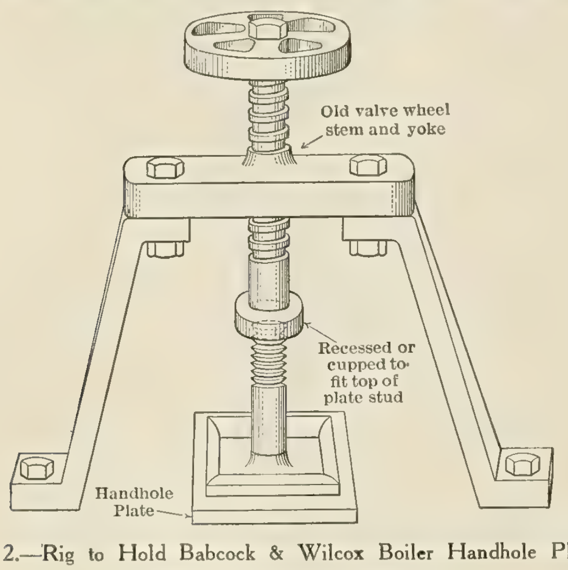


Fig. 2.—Rig to Hold Babcock & Wilcox Boiler Handhole Plates While Cleaning Gasket Seat

When the writer first took charge of the work of cleaning the boilers, the method in use was that of using the bench vise to hold the plate while running over the stud with a die stock to clean the threads of the stud. As there was but one vise available to each fireroom, it permitted but one man to do this work at a time. The cleaning of the gasket seat was done by men sitting astraddle of a plank and holding the plate in a recess in the plank, scraping the seat with a scraper. This was a very poor means and caused serious waste of time. The nuts for the plate studs were also held one at a time in the bench vise and retapped. One can see how slow such methods were. While the writer does not claim to be an efficiency expert nor an inventor of labor-saving devices, he has managed to speed up the work in such a way with the aid of these homemade devices that the whole time of cleaning the plates and seats on one boiler is accomplished with ease in eight hours by six men, where the old method took sixteen hours with eight men.

When starting to take the plates off the dirty boiler, one man takes the regular long lever plate nut wrench and goes ahead loosening up the tight nuts. He is followed by another man with a light skeleton wrench made from pipe, shown in Fig. 1. This man unscrews the nuts right off, throwing them into a coal bucket, and the plate dogs into a pile. Another man follows him, kicking the plates in and taking them out of the header. He puts these into a pile. As the plates, dogs and nuts begin to pile up, men start work cleaning them.

The rig used for holding them down securely to the bench while they are scraped is shown in Fig. 2. It is made from old valve parts. The screw or old valve stem is recessed on its end to fit easily over the plate stud, and a quick turn of the valve wheel secures the plate, thus holding the plate permitting the worker to use both hands in working the scraper cleaning the old gasket off the seat.

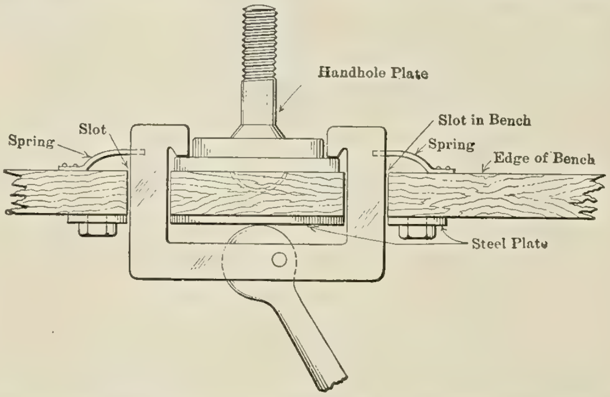


Fig. 3.—Clamping Rig for Babcock & Wilcox Handhole Plates While Running Die Over Studs

After the seat is cleaned, the plate goes to the next man on the bench, who runs the die over the stud threads. The special plate-holding rig is shown in Fig. 3. This device is quickly and easily operated. It is worked by an eccentric clamp and lever. The rig consists of just two pieces, the U-shaped clamp and the eccentric lever. There are two pieces of flat spring steel used to raise the device when the clamp is released. A metal plate is secured to the under side of the bench to reinforce the edge of the bench where the slots are cut. This plate also acts as a wearing plate for the clamp to work on. A small recess

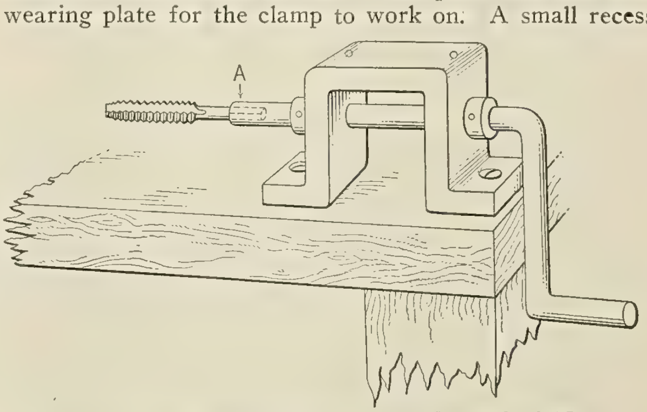


Fig. 4.—Nut Tapping Rig with Special Long Shank Taps

is cut in the bench for the round head of the handhole plate stud, as indicated by the dotted lines.

The stud nut tapping rig is shown in Fig. 4. This is a very simple affair, easily constructed and one that permits the rapid re-tapping of the nuts. The taps used have special long shanks, permitting four or five nuts to be run on the tap before taking the top off to remove the nuts. The squared section of the tap shank that enters the chuck at *A* is $1\frac{1}{2}$ inches long and is an easy fit. This length setting in the chuck insures the tap staying in there with nothing else to hold it, and as the nuts are always fed on against the tap nothing tends to pull it out.

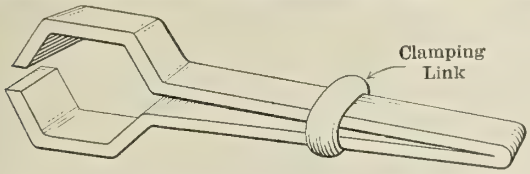


Fig. 5.—Nut Tongs for Holding Nuts While Tapping

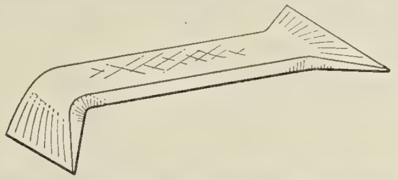


Fig. 6.—Scraper for Cleaning Handholes

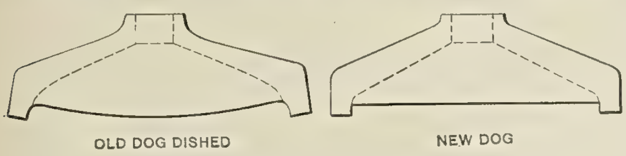


Fig. 7.—Before and After Straightening

Light, easily operated nut tongs for holding the nuts while tapping are made of $\frac{1}{8}$- by 1-inch strap iron, as shown in Fig. 5. Small scrapers for cleaning the inside seat of the handhole in the headers are made of small, flat files that are worn out and of no further use for filing. These are shaped as shown in Fig. 6. A plentiful supply of these kept sharp are needed.

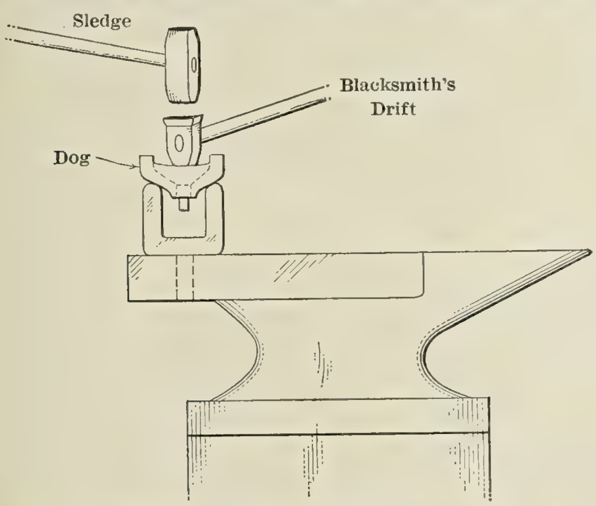


Fig. 8.—Method of Holding Dog on Anvil

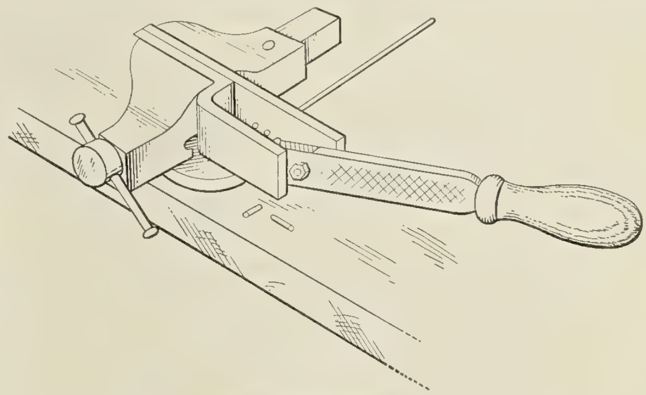
Many of the plate dogs that have been pulled up pretty tight to keep the plate gaskets from leaking become dished so that they touch the plate in the center. When they are found dished like this, they are put in a separate pile and a man is put to work re-shaping them. The dog is heated cherry red and then held over a U-iron on the anvil and driven back with a sledge and a blacksmith's drift, as shown in Fig. 8.

The writer has described these home-made rigs and ideas to show how we have schemed to lighten the work. If any of the readers have better or similar ideas, let's have them. We will all benefit by them.

C. H. Willey.

Pin Shear

Where it is necessary to cut a lot of small pins or shear small round stock, such as brass, copper or drill rod, a very handy and efficient shear for the purpose may be very easily and quickly made from a piece of flat stock and an old flat file. The file should have a hole punched in it about 4 inches from the tip, and one edge sharpened, the side of the file working on the stock being ground smooth. A length gage can be made of similar thin flat stock, and the whole thing held in the bench vise.

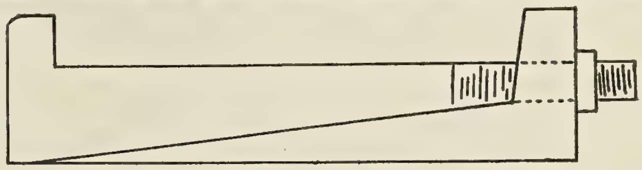


Drill Rod Cutter

Handy Man.

Curing a Troublesome Loose Flywheel

On a small air compressor we encountered considerable trouble because the flywheel which was keyed to the shaft frequently worked loose and began to creep. New keys were tried out without avail, until a visitor suggested that we use a wedge key which he described as shown in the accompanying sketch. This was made up of two parts so arranged that they could be pulled up and wedged by turning a bolt on the one end. We had one of these made up and installed on the wheel. After adjusting it several times and taking up the slack it kept tight and altogether eliminated the trouble previously encountered.



Wedged Key to Hold Flywheel

Philadelphia, Pa. W. A. Lailer.

The "coming in" of the electrically welded ship is shown by the significant action of Lloyd's Registrar of Shipping in England. The company has taken a very active stand toward electric welding, has spent large sums of money in experimental work and recently issued provisional regulations under which ships built wholly by electric welding will be separately classified.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

CONDUCTED BY "NAVAL ARCHITECT"

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

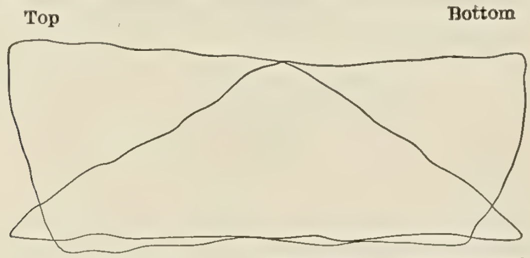
There will appear in this column from time to time questions which have been asked by the Board of Steamboat Inspectors in the various examinations for engineers' licenses conducted by them. Such questions will be denoted by an asterisk (*) placed before the number if from examination for grade of chief, and by a dagger (†) if from examination for other grades.

Horsepower of a Triple-Expansion Engine

Q. (988).—Using your own data, sketch a set of cards for a triple-expansion engine and work out the horsepower of same. I have in mind an engine that I trust you will take the dimensions of and use them as data for this problem. The cylinders are $14\frac{1}{2}$ inches, $23\frac{1}{2}$ inches and 39 inches in diameter by 28-inch stroke. The boiler pressure is 180 pounds per square inch and the engine turns at 100 revolutions per minute.

A. (988).—To illustrate one efficient method, suppose we proceed as follows: Having given the area and the length of the indicator diagrams, work out in detail the

Top Bottom



Scale 80 Lbs. per Square Inch

H. P. CYLINDER

horsepower for one diagram. The total horsepower is simply the sum of the horsepower of both the top and bottom ends for all the cylinders This is best illustrated by making a table, as has been done several times in the columns of this magazine.

Top Bottom

Scale 30 Lbs. per Square Inch

I. P. CYLINDER

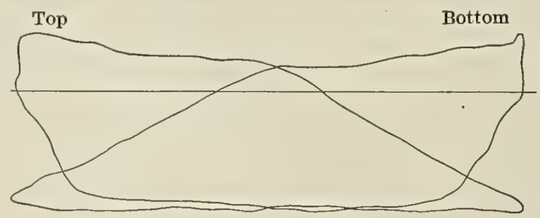
Engine, $14\frac{1}{2}$ inches by $23\frac{1}{2}$ by 39 inches, with 28-inch stroke. Boiler pressure, 180 pounds per square inch; 100 revolutions per minute. Take the diameter of piston rod as $4\frac{1}{2}$ inches.

The first step is to find the area in square inches of each card, together with its length in inches. A planimeter will furnish the easiest method of obtaining the area, although it can be found by any of the rules given for that purpose. For our purpose, let us take the bottom end of the high pressure cylinder. Since the area of the diagram is 3.20 square inches and the length is 3.52 inches, the mean height is

$$\frac{3.20}{3.52} = .909 \text{ inch.}$$

As the scale of the diagram is 80 pounds per square inch,

Top Bottom



Scale 16 Lbs. per Square Inch

L. P. CYLINDER

the mean effective pressure (M. E. P.) is $.909 \times 80 = 72.7$ pounds per square inch. Our formula for indicated horsepower is

$$\frac{P\ L\ A\ N}{33{,}000}$$

P = mean effective pressure in pounds per square inch.
L = stroke of engine in feet.
A = area of piston in square inches.
N = number of working strokes per minute.

In this case the area of the piston will be that circle of $14\frac{1}{2}$ inches diameter minus the area of a $4\frac{1}{2}$-inch circle (thus allowing for the piston rod), or $165.1 - 12.6 = 152.5$ square inches.

Hence we have for the bottom end of the high pressure cylinder,

$$\text{Indicated horsepower} = \frac{72.7 \times 2.33 \times 152.5 \times 100}{33{,}000} = 78.3.$$

Below we have tabulated the horsepower of the whole engine:

Cylinder	H. P.		I. P.		L. P.	
Diameter cylinder	14.5		23.5		39	
Area cylinder, square inches	165.1		434		1,195	
Area, piston rod	12.6		12.6		12.6	
	Top	Bottom	Top	Bottom	Top	Bottom
Area, piston	165.1	152.5	434	421	1,195	1,182
Area, card, square inches	3.45	3.20	3.25	3.39	2.38	2.36
Length of card	3.52	3.52	3.68	3.68	3.46	3.46
M. E. P.	78.3	72.7	26.5	27.6	11.03	10.92
I. H. P.	91.5	78.3	81.1	81.0	93.2	83.6
		169.8		162.1		176.8

508.7 =total I. H. P.

Size of Attached Feed Pumps

Q. (989).—(1) What is meant by developing one horsepower on 100 pounds of steam per hour? I see often where a certain pump or engine consumes so many pounds of steam per hour. Please explain to me how I may figure the pounds of steam per hour that an engine or pump is using to develop a certain horsepower.

(2) What is the relation of sizes of the cylinders of triple expansion marine engines? Knowing the diameter of the high pressure cylinder, how would you figure out the diameter of intermediate pressure and low pressure cylinders?

(3) Knowing the diameter of a high pressure cylinder of a compound

engine, working pressure, revolutions per minute, etc., how would you find the size of a single-acting plunger pump to handle the water of condensation from filter box to boiler as a feed pump—the pump to make a stroke with every revolution of engine?

A. (989).—(1) In marine practice, steam consumption of engines and turbines is commonly expressed as so many pounds per horsepower per hour. Accurately to find the steam consumption of a certain engine requires that the condensed steam used by the engine be weighed over a definite period of time. The average indicated horsepower during this period may also be computed by taking cards and other data. It is an easy matter to obtain the amount of steam used per hour for the main engine. Dividing this quantity by the average indicated horsepower will give the steam consumption per indicated horsepower per hour.

(2) The relative sizes of engine cylinders of a marine engine depend partly on the boiler pressure. To save weight, the designer may find a certain size desirable. A common rating for merchant type engines working at 160 pounds pressure is the following:

$$\text{Intermediate } \frac{\text{L. P.}}{\text{H. P.}} = 2.6 \quad \frac{\text{L. P.}}{\text{H. P.}} = 6.8.$$

Since the cylinders have the same length of stroke, the following relation for the intermediate pressure cylinder will hold:

$$\frac{\frac{\pi}{4}(D_2)^2}{\frac{\pi}{4}(D_1)^2} = \frac{2.6}{1}$$

where D_1 and D_2 are diameters of the high pressure and intermediate pressure cylinders, respectively. In a similar manner the diameter of the low pressure cylinder may be found. (In a new design the size of the low pressure cylinder is usually determined before the high pressure.)

(3) Attached feed pumps should be installed in duplicate, and each one should have capacity enough (assuming no leakage) to supply double the amount of feed water required. Knowing sufficient data of the main engine, we may estimate its steam consumption. The steam consumed by auxiliaries will be perhaps one-tenth more. If d is the diameter and s the stroke of each attached feed pump, we shall have

$$n \times \frac{\pi d^2}{4} \times s = 2\,W,$$

n being the revolutions per minute of main engine and W the pounds of feed water fed per minute, which, excluding minor leakage, will be the steam consumption of main engines and auxiliaries. The stroke of pump may be one-third to one-half that of the engine.

ORGANIZING THE EMPLOYMENT DEPARTMENT.—As it is becoming increasingly difficult to supply skilled workers for shipbuilding, the shipyards are confronted with the problem of increased production with a decrease in the supply of workmen. In order to keep up production under these conditions, most careful thought must be given to the selection, placement and methods of retaining a competent and loyal force of workers. As an aid in accomplishing this result, the employment management branch of the Industrial Service Section of the United States Shipping Board Emergency Fleet Corporation is issuing a series of bulletins dealing with the proper handling of employment problems. The methods and processes outlined are those that have been found useful by some of the largest shipyards and corporations in the United States.

NEW BOOKS

PRACTICAL SHIPBUILDING. By J. D. MacBride. Size, 5 by 7½ inches. Pages, 231. Illustrations, 100; folding plates, 2. New York, 1918: D. Van Nostrand Company. Price, $2.

In the great army of volunteers which responded to the nation's call for men to build our emergency fleet, few had any knowledge of ships or shipbuilding. To initiate such men into the intricacies of shipyard work, the author has compiled a handbook in which are explained in simple language the functions and nature of the work of the various departments in a shipyard, the duties of each group of workers and their relation to each other. The various shipyard tools and appliances are described, together with the parts of a standard type of cargo steamship, and this is followed by a glossary of shipbuilding terms. The book is purely descriptive and does not enter into the engineering features of shipbuilding, but it will prove a valuable aid for new men starting in shipyard work.

AIDS TO EMPLOYMENT MANAGERS AND INTERVIEWERS ON SHIPYARD OCCUPATIONS. Size, 6 by 9 inches. Pages, 147. Philadelphia, 1918: United States Shipping Board Emergency Fleet Corporation.

As it is more economical and more expedient to spend five or even ten minutes in properly placing a new worker in a shipyard than it is to spend two hours or sometimes two days in trying to replace him, employment managers and interviewers will find it advisable to consult this carefully compiled handbook which lists the occupations and describes the trade, physical and mental requirements as well as the education and experience essential for applicants to qualify for the various positions in a shipyard. The book is one of a series on employment management supplied by the employment management branch of the Industrial Service Section of the Emergency Fleet Corporation. A supplement will be issued covering the shipyard occupations in which handicapped persons of various types can be employed.

MODERN SHIPBUILDING TERMS DEFINED AND ILLUSTRATED. By F. Forrest Pease. Size, 5 by 7¼ inches. Pages, 143. Illustrations, 82. Philadelphia, 1918: J. B. Lippincott Company. Price, $2 net.

Some two thousand terms applied to ships and shipbuilding, 350 of which are illustrated, are clearly and concisely defined in this book. The illustrations, most of which are reproductions of photographs taken in our best-equipped shipyards, are an especially valuable feature, as the parts of ships or shipways defined are clearly indicated with reference letters or figures. Several appendices contain more complete explanations of the shipyard trades and the duties performed in each, as well as of electric and gas welding and the Isherwood system of shipbuilding.

STEEL SHIPBUILDERS' HANDBOOK. By C. W. Cook, M. A., B. S. in C. E. Size, 4½ by 7 inches. Pages, 123. Folding plates, 4. New York, 1918: Longmans, Green & Company. Price, $1.50 net.

This handbook is an encyclopedia of names of parts, tools, operations, trades, abbreviations, etc., used in the building of steel ships. About 1,600 names are defined and 300 parts illustrated. The definitions have been arranged alphabetically and cross-referenced as completely as possible. The work is the result of a careful study of the latest and best methods used in the large shipbuilding plants all over the country and of the best text-books on steel shipbuilding.

Shipbuilding and General Marine News

**Contracts for New Ships—Shipyard Improvements—
Engineering Projects—Improved Appliances—Personal Items**

EXTENSIVE ADDITIONS TO UNITED STATES NAVY PROPOSED BY NAVAL BOARD

Three-Year Programme Calls for Sixteen New Battle Cruisers and 108 New Destroyers

As outlined by Rear Admiral Badger before the Naval Affairs Committee, the General Naval Board contemplates adding sixteen new battle cruisers, according to the 1920 three-year building programme, to the six which are already under construction. The United States would then have twenty-two superdreadnoughts of the most advanced type.

The new programme also calls for 108 new destroyers. At present the Navy possesses about 500, and authorization has already been given for the building of at least 342 more.

The six battleships about to be laid down will carry a main battery of twelve 16-inch guns. They will have a total displacement of about 43,000 tons and can maintain a speed of 23 knots under ordinary operating conditions.

The new three-year program as recommended by Secretary Daniels would mean an appropriation of $600,000,000 to insure the completion of plans which he considers essential for the maintenance of our position in the partnership policing of the high seas. If a league of nations, or special terms of the peace treaty shall make it of less necessity for individual nations to have large navies, the program will undoubtedly be revised along these lines.

Schwab's Resignation Accepted

With the shipbuilding programme well advanced and adequate machinery in operation to carry on the work of building up a large merchant marine, Director General Schwab feels able to turn his attention to the affairs of the Bethlehem Steel Company again. The services which he has rendered to the whole country by his unqualified success in pushing through the shipbuilding programme cannot be estimated.

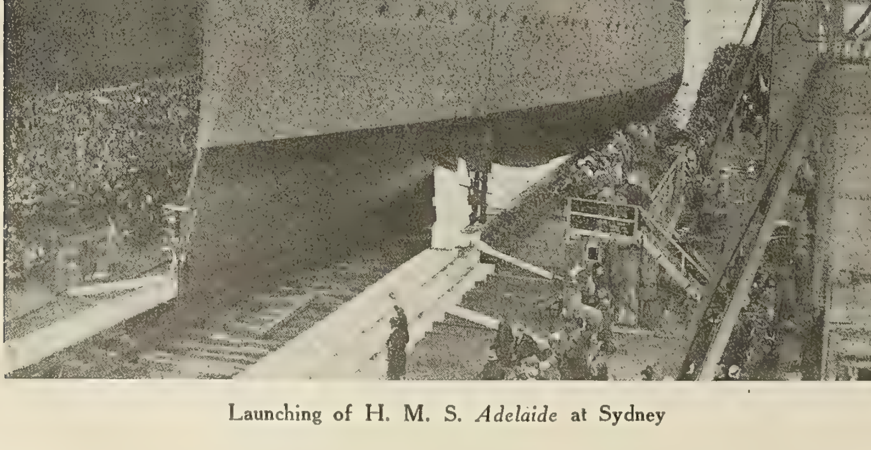
Shipbuilding Profits in Japan

Shipbuilding is evidently profitable in Japan. The directors of the Osaka Iron Works have decided to pay a dividend of 35 percent for the last term, or 10 percent higher than for the preceding half year. The net profit realized by the Kawasaki Dockyard Company during the first half year amounted to 14,030,000 yen.

Australian Warship Adelaide Launched

His Majesty's warship *Adelaide,* launched from the slipway at the Commonwealth Naval Dockyard, Cockatoo Island, Sydney, is the largest ship ever built in any part of the British dominions. The christening ceremony was performed by Lady Helen Munro Ferguson.

This ship was launched in much less time than the last warship, due, probably, to the absence of labor disputes, the improved machine tools and the increased experience of the workmen. Practically all of the material for the construction work of the hull was imported.



Launching of H. M. S. *Adelaide* at Sydney

FINDINGS OF HOG ISLAND INVESTIGATION MADE PUBLIC

No Grounds Found for Criminal Prosecution, but Careless and Extravagant Expenditures Alleged

Since the issuing of the report of the Department of Justice concerning conditions at the Hog Island shipbuilding plant on December 20, the country has been in possession of the facts upon which previous criticism has been based. The investigation, made by two assistants to the Attorney General, aided by two naval technical advisers, Civil Engineer Archibald L. Parsons and Naval Constructor S. M. Henry, covered facts observed from February, 1918, through the early part of July.

When the American International Corporation—composed unofficially of the engineering firm of Stone & Webster and the New York Shipbuilding Corporation—agreed to buy 846 acres of land at Hog Island to be utilized for shipbuilding purposes upon a 6 percent rental basis, the estimated cost of constructing the yard was $21,000,000. Subsequent changes added $2,750,000 on account of the additional seventy ships later contracted for, and $3,250,000 on account of subsoil conditions, etc.

The investigating committee very frankly stated that they found no evidence, except certain minor frauds, as grounds for a criminal prosecution. They were, however, decided in their condemnation of careless and extravagant expenditure.

Waiving all minor questions of controversy, the outstanding fact is that the agent's summer and fall estimates of $21,000,000 and its November 27 estimate of $27,000,000 have been so far exceeded that the probable cost of the yard will be about $61,000,000 (including $6,000,000 for recent additions).

The most significant single fact indicating the point of view at Hog Island was that bills for material, largely lumber, were prepaid (and properly prepaid) to the extent of over $10,000,000, but no effort was made to check the actual receipt of the material paid for.

As a means of comparison, it was cited that the total cost of $1,100,000 per slip at Hog Island is hardly compatible with the report that the cost at Bristol was only $699,000, and at Newark Bay $390,000.

As a satisfactory handling of the situation, the committee recommended that it would be advisable to submit the matter to a board of arbitration, to consist of three distinguished naval architects—one selected by the committee, one by the Fleet Corporation and one by an agent of both parties involved.

COLUMBIA ORGANIZES NEW CLASS FOR SHIP DRAFTSMEN

Brooklyn Polytechnic to Teach Marine Engineering

The evening classes at Columbia University, covering ship drafting, which were opened as a war necessity, will be continued to supply competent men for drafting positions in the post-war developments. These classes are planned under the direction of Thomas H. Harrington, professor of mechanical drafting; Arthur Bolton, M. I. N. A., chief hull draftsman, Federal Shipbuilding Company, formerly with New York Shipbuilding Company, Sun Company and Argentine Naval Commission, and Richard F. Bach, curator at the school of architecture.

The Polytechnic Institute, Brooklyn, is organizing a new evening course in marine engineering, to start shortly after January 1. The course is planned for those who are now employed in some of the various forms of marine activity in New York and vicinity who intend to remain in the field and who feel the need of supplementing their present qualifications by further study. It will include the study of the steam power plant of a modern ship, calculations involved in its design and construction, also testing and operation. Subjects of resistance and propulsion will also be included, and consideration given to the design and operation of the internal combustion engine. The course will be conducted under the direction of E. S. Church, Jr., professor of mechanical engineering.

WELIN MARINE EQUIPMENT NOW INCORPORATES WITH AMERICAN BALSA

Brings Raw Material and the Manufacturer Together

The American Balsa Company, Inc., has recently been organized, with a capital of $1,000,000, to take over the Welin Marine Equipment Company and the American Balsa Corporation, with offices at 50 East Forty-second street, New York City. Directors of the American Balsa Company are: A. P. Lundin (chairman), B. C. Carpenter, J. F. Case, George S. Lewis, George Mixter, William Finlay Morgan, R. B. Sheridan, C. C. Stillman, Beekman Winthrop. The officers are: George S. Lewis, president; A. P. Lundin, William Finlay Morgan, S. B. Sheridan, vice-presidents; Cecil Page, secretary; Percy Mayes, treasurer. At the present time the American Balsa Company is operating plants at Long Island City, Astoria, L. I.; on the Harlem River, New York, and Delawanna, N. J. Practically the entire output is taken by the United States navy, the United States Army Transport Service and the Emergency Fleet Corporation. The principal products are Welin davits and Lundin lifeboats, standard for United States transports, special buoys, Balsa wood for hydroplane construction and A-B-C liferafts and life preservers. As soon as war conditions permit, the manufacture of insulation material, especially for refrigerator ships, will be developed.

PLAN RECONSTRUCTION OF BELGIAN COMMERCE

Royal Belge in the Market for Ships—Twenty-four Destroyed by Submarines—Belgian Agents Seek Business

War-scarred Belgium has taken the first steps toward commercial rehabilitation by planning the immediate expansion of the Royal Belge fleet. The corporation was organized when the war broke out, with H. Arthur Brys at its head, and at once turned over to the Belgian Government a fleet of forty ships for war purposes. Only sixteen vessels now remain; the other twenty-four having been sunk by submarines or mines. Twelve of the remaining ships are temporarily flying the British flag, carrying supplies to France and acting in the service of Belgian relief.

Expansive developments, however, are immediately contemplated, and Joseph A. Nash, for four years general manager of the Shipping and Purchasing Department of the Committee for Relief in Belgium, has established offices at 141 Broadway, New York City, to undertake the work. The organization, which is backed by King Albert, is in the market for ships. It is hoped that connections will soon be re-established with the Antwerp office and the actual rehabilitation of the commercial venture begun.

The speed with which she does this will depend upon two factors—the amount of industrial rehabilitation accomplished at home and the number of vessels she will have at her disposal for import and export. There is one thing which Americans must bear in mind—Belgium still has huge resources.

With the signing of the armistice progressive Belgium agents are already seeking opportunities to become representatives of American manufactures in the rehabilitated country. W. C. L. Lamont, whose present address is 22 Northumberland avenue, London, W. C. 2, is planning to return to Antwerp, and will be open for propositions to handle American products.

Mr. Lamont's previous connections with the Association des Industriels Belges, Etablis dans le Royaume-Uni, Secretary to the Ligue Maritime Belge (Section Britannique), member of the Government advisory committee for Belgian inland transportation (London), and secretary and treasurer to the Belgian Barge Owners' Federation, are sufficient recommendations to establish his familiarity with the marine field.

U. S. Ship Loss was 138 Vessels

From war causes the American merchant marine lost 138 vessels, totaling 311,868 gross tons, with a loss of life of 500 persons. These figures are based on the reports of the United States Bureau of Navigation. The American tonnage lost is less than one-fifth of the British losses and less than one-third that of all other Allies and neutrals.

Only one American vessel of over 10,000 tons was lost—the tanker *O. B. Jennings*, 10,289 gross tons, sunk during the U-boat activities of last August. Out of the total of 138 American vessels sunk only nineteen were over 5,000 gross tons.

The above figures take no account of losses of ex-enemy or ex-Dutch steamers which were temporarily under our flag.

PRESIDENT LANDS AT BREST

Harbor Improvement Made to Handle Army Shipments

Since our entry into the war the harbor of Brest has been deepened and equipped with the most modern terminal facilities, to speed the landing of ordnance and food supplies for the American troops in France. This is probably one of the largest, most advanced engineering feats undertaken within recent years, and has been completed with phenomenal speed. It is fitting, therefore, that the port, which is also the largest naval base of the United States forces abroad, should welcome the President to France on December 13.

Shipping Activity at the Harbor of Brest

Huge Gang Drill for Steel Work

Three minutes to drill 18 feet of circular seam on the flat with one setting of the machine is the record of a huge gang drill invented and designed by Aaron Hill, Los Angeles, California. This new machine, which has an eighty-drill capacity, can be set to any ordinary assembly desired. Spacing is facilitated by a steel scale on the machine, thus entirely eliminating laying out or the use of tack holes in the plate previous to rolling. The machine can handle angles of every shape, channels, I- and H-beams, and plates of any length.

The machine is particularly valuable for boiler work. Here it eliminates the older, slower process of punching small holes and then rolling shell plates and reaming. Warping, dishing, stretching and crystallizing of the metal are, accordingly, dispensed with, and in assembling the delay and annoyance of making oversized holes.

In drilling the drums of boilers the inner butt strap is placed upon the beam, and held in position by special gage bolts. The beam is then run inside of the drum shell, which is already rolled up without holes in it. By special slings the beam and drum are lifted onto cradles. The outer butt strap is then placed in position, when the automatic clamps with which the machine is fitted clamp the straps and drum down upon the beam with a pressure of over 20 tons. Set and spaced, the drill runs one complete row longitudinally and then releases itself automatically.

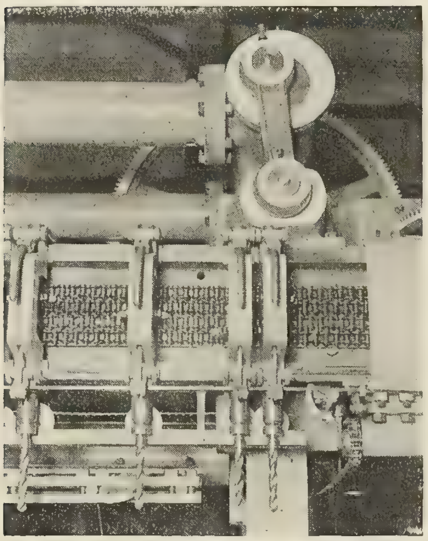


Fig. 1.—Spindles of Gang Drill

The cradle is geared so that it can be moved circumferentially to bring the next pitch in line for drilling the next row of holes. The handles shown in the front of Fig. 1 make it possible to remove any spindle which may not be required for certain drilling. Larger spindles can also be put in place and 3¼-inch tube holes drilled—thirty-two can be accommodated at once. Four of these drills are being built by the Badenhausen Company, manufacturers of watertube boilers, 1425 Chestnut street, Philadelphia, at their Bound Brook factory. The first one is installed at the boiler shop at Cornwells, Pa.

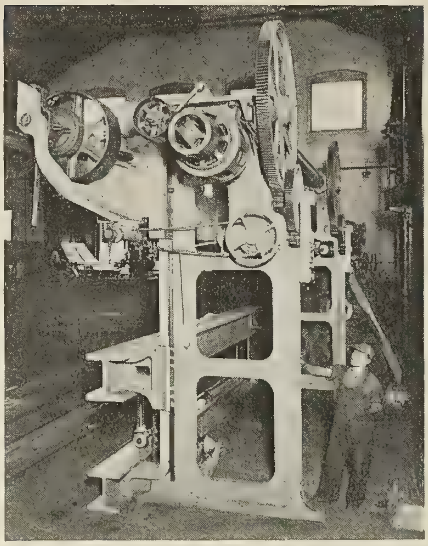


Fig. 2.—End View of Gang Drill Showing Driving Mechanism

French Inland Waterway Development

A project for the construction of a canal between Paris and Dieppe is now receiving consideration. The scheme is the revival of a very old plan. It is believed that the trading conditions which will prevail after the war have given the project a new importance. The Seine is not able to deal with the traffic that is now offering, and there have been as many as seventy ships in the estuary awaiting their turn to enter Rouen, besides 1,300 barges awaiting their turn to leave. The canal is designed to accommodate the largest boats at present traversing the French waterways, which carry 1,400 tons, and are 88 meters in length, with a draft of 3 meters when loaded. The barges are to be hauled by electric locomotives running on a track alongside the canal or on a roadway. The canal would be 165 kilometers in length, as compared with the route by the devious River Seine, which is no less than 350 kilometers long.

U-Boat Toll Reaches 15,000,000 Tons

The world's sinkings since the outbreak of the war down to September 30 last, according to the figures of the British Admiralty, were 14,825,635 gross tons, distributed over the war years as follows:

1914 (five months)	681,363
1915	1,724,720
1916	2,797,866
1917	6,623,623
1918 (nine months)	2,998,063
	14,825,635

This means that the U-boats destroyed almost exactly one-third of the amount of steam tonnage in existence in the world when the war broke out. The toll of destruction is greater than the combined merchant fleets, at the beginning of the war, of the United States, Norway, France, Japan, Italy, Sweden, Austria and Holland. It is almost equal to the steam tonnage of Britain in August, 1914, which was 18,892,089 gross tons.

Snap Switch for Marine Service

A new switch for marine purposes is here illustrated. The base is of unbreakable molded composition with ratchet plates also molded—thus eliminating the possibility of the mechanism becoming loose. The ratchet is, of course, made of steel to stand up in severe service, but is copper-plated to prevent rusting. The music wire spring, which actuates the mechanism, is also heavily copper-plated. This switch is made by the Bryant Electric Company, Bridgeport, Conn., in both single and double pole. Where watertight covers are employed a ⅜-inch extension stem for handle is offered. The size of the bases, as molded, accommodates standard screw spacings for attaching the switch to the box. A groove is provided on the back of the base of suitable size to permit the running of a separate circuit through the box.

Bryant Marine Snap Switch

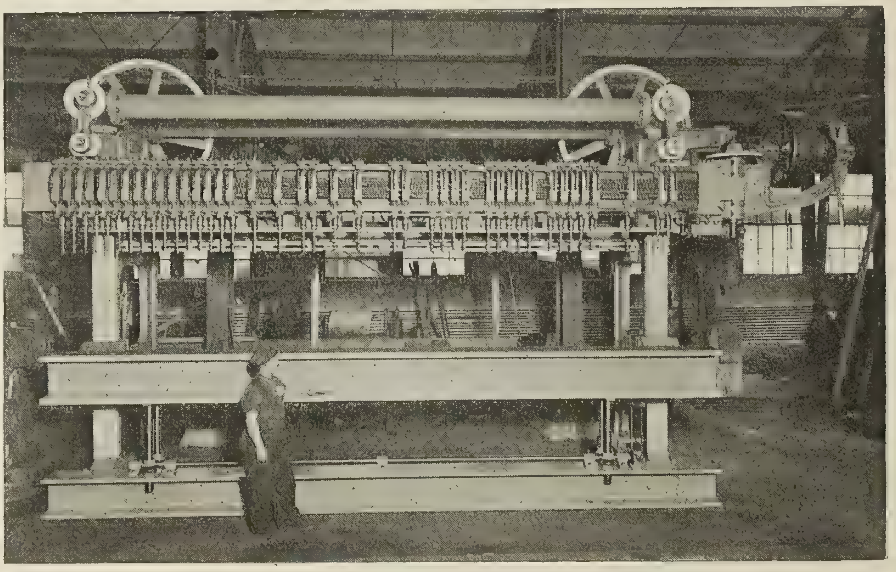
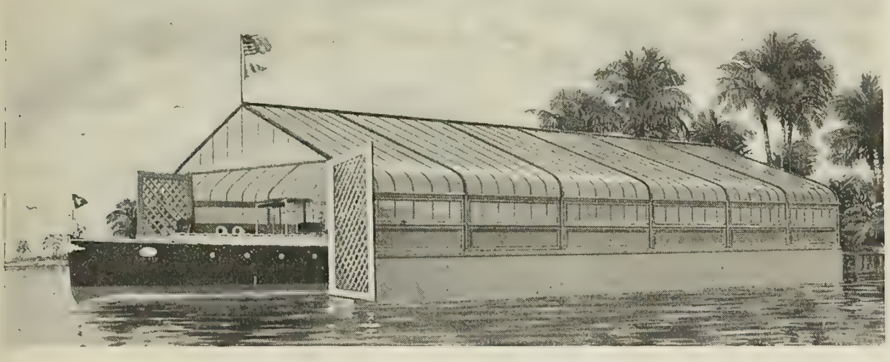


Fig. 3.—Gang Drill for Boiler Plate Work

Glass Boat House

An unusual yacht novelty in sub-tropical regions is furnished by the new glass boat house which is being built for Lee R. Rumsey, of New York City, at his winter home at Alton Beach, Miami, Fla., probably the first glass boat house ever constructed. Glass has been widely used in the construction of conservatories and swimming pools; its application, however to boat houses comes as a distinct departure, though, when its advantages for this purpose are considered, it is a wonder that no one thought of it before.



Glass Boat House for Southern Waters

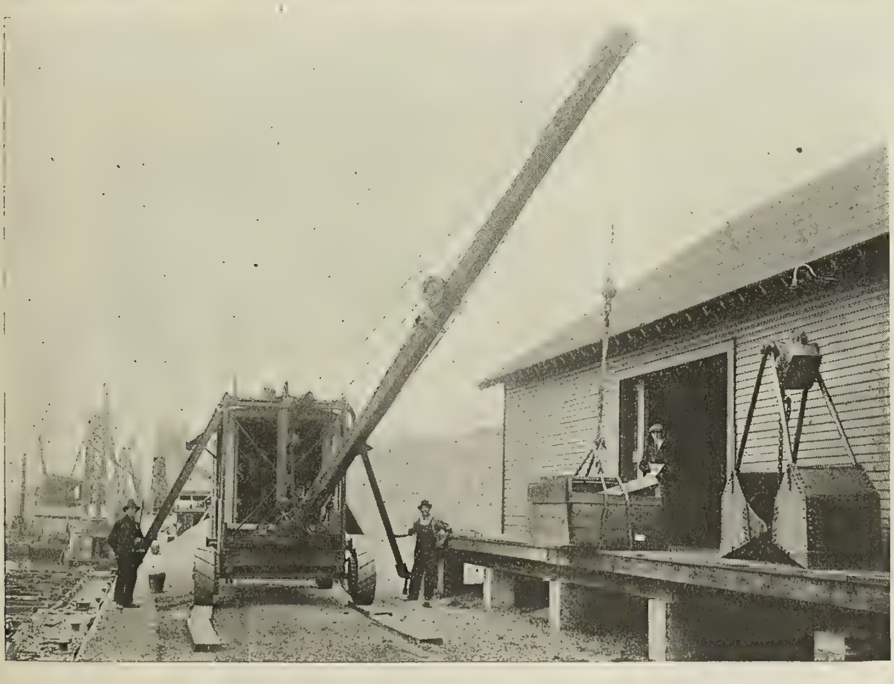
The boat house is of pleasing lines, with curved eaves. With the roof and sides constructed of glass there is little chance of mildew. It can be washed down with a hose from top to bottom. There is not a dark spot in the whole structure. The supporting framework is of cast iron and steel, heavily galvanized. The glass used in glazing is ground, which softens the direct rays of the sun, while giving the maximum amount of light. The double doors are of wood, with an open lattice pattern that insures good air circulation.

In designing the structure the architects, Lord & Burnham, of New York City, aimed to secure conditions approaching a boat at anchor, with a suitable covering to shield it from the weather. The foundation is of concrete.

Auto-Crane for Terminal Freight

The concentration in shipping incident to the present emergency has served to emphasize the demand for more efficient means of handling freight at terminals. The extension of inland water traffic has created a similar "urge." Varied apparatus is constantly being originated to handle this new and developing situation.

Among efficient machines stands the "Auto-Crane," eighteen of which are being used on the New York State Barge Canal at various terminal points for unloading and loading freight from the barge. The accompanying illustration shows one of these cranes. This crane, which is manufactured by the John F. Byers Machine Company, Ravenna, Ohio, is all-steel. Being of the semi-locomotive, self-propelling type, either forward or reverse, it is particularly adaptable for operation where the moving of the apparatus is necessary to cope with the varying loading and unloading conditions. In fact, these cranes have been installed by the War Department at Bush Terminals in Brooklyn, Newark, Norfolk and Charleston, S. C., to more efficiently handle freight from cars at terminals.



Auto-Cranes Used on New York State Barge Canal and at Bush Terminals

The Auto-Crane can be equipped with three kinds of power—steam, gasoline or electricity. Three kinds of mounting are also available—road wheels, rail trucks and caterpillars.

It is capable of handling loads up to 3 tons at 12-foot radius, when being used in connection with hook for derrick work; when used for loose material handling, with clam-shell bucket, it will satisfactorily handle a ¾-yard clam-shell bucket of 2,400 pounds. It will accommodate orange peel buckets up to half a cubic yard in size.

"Faithful Service" Badges Awarded on the Great Lakes

In the October issue of MARINE ENGINEERING an article appeared claiming that the employees of the Passaic River yard of The Foundation Company were the first to be awarded badges for "Faithful Service" by the United States Shipping Board.

Foundation Company's Service Badge

It may be of interest to know that the Cleveland office of the United States Shipping Board was among the first, if not the first, to use this method of awarding its faithful employees.

The Cleveland office of the United States Shipping Board awarded "Faithful Service" badges for the three consecutive months of July, August and September of this year. The illustration shows the design of badge used. The color scheme for the July bar was a red background with gold letters; the August bar was white and gold and the September bar blue and gold. When the badge was presented a bar was attached. It has been the intention of the Shipping Board to inspire the men in the shipyards to continue to perform faithful service and win the other two bars, thereby showing a perfect record at the end of three months by winning the national colors. This would necessitate that the men remain in one place, and not shift from one yard to the other.

About sixteen hundred and sixty-five badges have been presented to the men

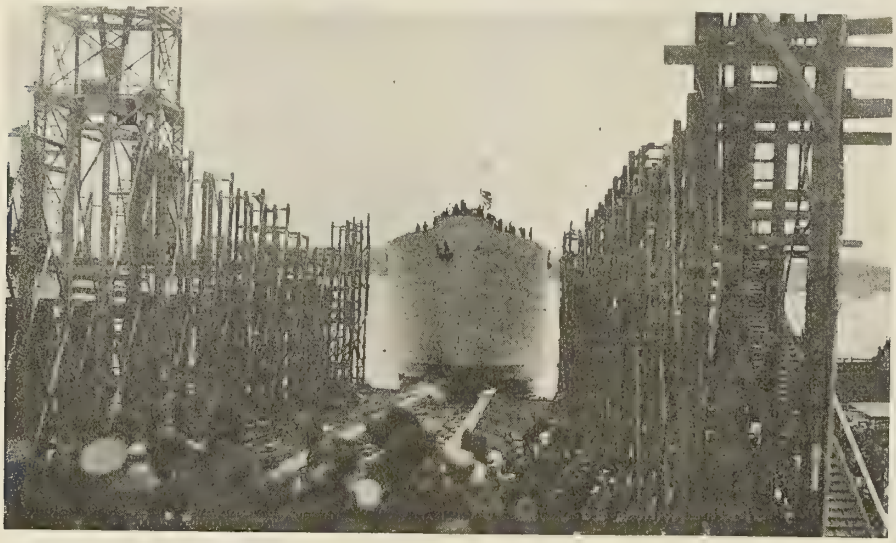
in the Great Lakes yards. Many have won the three bars.

In years to come the possessor of one of these badges can look back with much pride and satisfaction to the fact that he "did his bit" in helping to build "the bridge of ships" which will constitute the world's greatest merchant marine after the war. It is "Faithful Service" on the part of the men in the shipyards that is making this possible.

RECENT LAUNCHING RECORDS

America and Great Britain Still Full Speed Ahead

The 9,400-ton deadweight ship *Diablo,* the first of ten contracted for by the Shipping Board from the Pacific Coast Shipbuilding Company, was launched on Suisun Bay, November 30.



Freighter *Tollard* Taking the Ways at Groton, Conn.

The steel freighter *Tollard,* which was launched on November 9, at Groton, Conn., is shown taking the ways in the accompanying illustration. Ground was broken for the construction of the Groton Iron Works shipyards, where this boat of 8,800-ton capacity was built, a little over a year ago.

The first concrete boat built in New England is the record of the Aberthaw shipyards. This boat, launched December 7, is the first of a number of lighters under construction by that company. It is 110 by 34 feet, with a depth of 11½ feet, flat bottom, square sides and sloping ends, and is divided into fifteen watertight compartments. It has a deadweight tonnage of 418 tons, with 500 tons carrying capacity. A second was launched December 21.

The Speedway Shipyard of the Gas Engine and Power Company and Charles L. Seabury and Company, Consolidated, of Morris Heights, New York, put overboard their fourth mine sweeper, *Seagull,* for the United States Navy at 2:30 P. M., December 24.

The Newburgh Shipyards, Inc., Newburgh, New York, launched a third 9,000-ton steamer December 21.

On November 19, a concrete vessel, the *Molliette,* was launched by Messrs. James Pollock Sons & Company, Upper Brents, England, into Paversham Creek. This probably represents the results of the first plans for straight-framed seagoing vessels developed on English soil. The dimensions are: Length over all, 131 feet; breadth, molded, 25 feet; molded depth, 11 feet 9 inches; draft, loaded, 9 feet 9 inches. The vessel is designed to carry 320 tons of cargo. The *Molliette,* which is a reinforced concrete vessel, will doubtless be the forerunner of other concrete vessels for coast trade.

Four large merchants ships were recently launched within ten days from Port Glasgow shipyards, three by Russell & Company, and one by W. Hamilton & Company. The four vessels aggregate nearly 30,000 tons gross. The first 8,000-ton standard vessel built by the Hebburn-on-Tyne yard of Palmer's Shipbuilding & Iron Company, Ltd., has been launched.

Discovery Used to Treat Burns

Fig. 1.—Ambrine Kit

In line with the utilization of successful war discoveries for peaceful pursuits is the adaptation of "Ambrine," a new surgical dressing, to the needs of American industry, and in that connection, to American shipyards. This dressing, which has been perfected by Dr. Barthe de Sandfort, a retired surgeon of the French army, is composed of certain paraffins and resinous gums scientifically combined to serve as a sealing poultice on burns. Dr. William O'Neill Sherman, chief surgeon of the Carnegie Steel Company, of Pittsburgh, was much impressed with the value of the dressing when he visited the Allied hospital at Issy-les-Moulineaux, where the treatment is used. The preparation has been adopted by the British Admiralty and army, the Belgian and Italian armies, all the French organizations handling the medical situation, and the United States army.

In application the material is heated to a temperature of less than 150 degrees F., and the viscous mass applied to the lacerated surface to cover the delicate, exposed nerve ends. The exclusion of air, of paramount importance in dealing with all types of skin and flesh wounds, is thus accomplished by the forming of a semi-flexible surface over the burned parts. Usually a supplementary dressing of medicated absorbent cotton is applied for purposes of convenience, through which heat can be imparted to the tissue.

Actual results obtained by the use of the process are shown in the accompanying photographs. The first photograph shows the very serious condition; the case was termed "burning in the second degree." The second gives the result of the treatment after thirty-five days. The installation on all merchant vessels of these first-aid kits, which supply apparatus for applying the preparation, now produced in American laboratories, is now under consideration by the Emergency Fleet Corporation. The Ambrine Laboratories, 347 Madison avenue, New York City, are placing the product commercially on the market.

Fig. 2.—Workman Suffering from Burn in the Second Degree

Fig. 3.—The Patient After 35-Days' Treatment

Unusual Hoisting Apparatus on Large Dredge

By a slight change in design, a floating dredge, which has previously given excellent service on small work, has been converted to handle much heavier work. The unusual feature of the new design is the carefully adjusted balancing apparatus.

The hull of the dredge is about 150 feet long and 50 feet wide; the boom, which is 70 feet on centers, carries a clam or orange peel bucket of 10 cubic yards capacity. The weight of the empty bucket is about 17 tons in air; when filled the bucket weighs 32 tons in air, 22 tons in water. This difference of 10 tons and the weight of the empty bucket cause great irregularity in the hoisting stresses. Accordingly, the bucket has been provided with an adjustable variable-controlled counterweight, so arranged that it will take up about 12 tons of its weight at times. When the bucket is below surface, however, the full weight is utilized to make it sink more rapidly into the material for filling. This compensating arrangement permitting uniform operation of the engines means economy of work and maintenance.

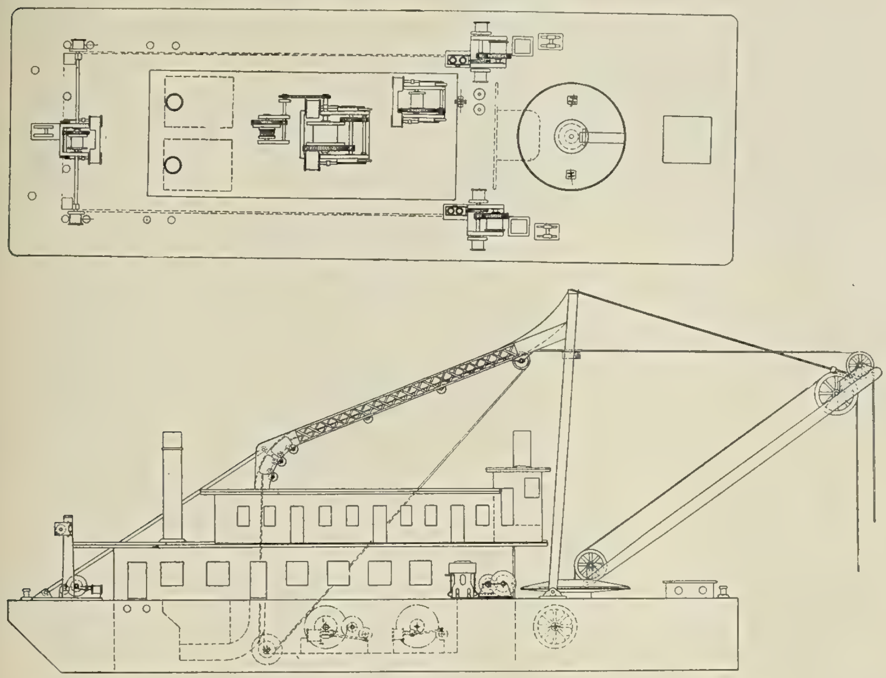
As may be noted from the illustration, the point of the boom is supported by steel cables and swivels at the top of the shear legs 53 feet high. The top of the shear legs is inclined slightly forward, and is attached to a vertical and longitudinal inclined strut about 55 feet long. This strut serves as a track for counterweights with endless cables, as shown, attached to a steel cable passing between horizontal guide sheaves at the shear legs and thence over the sheave at the end of the boom and down to the bucket, which is supported by it. Another line leads over a second sheave at the point of the boom and runs directly back to the main hoisting engine.

Arrangement of Balancing Counterweight

The proportion of the lines is such that when the bucket is in the water the counterweight is supported by the inclined strut on a track, sufficiently graded to ensure positive motion of the counterweight without causing much tension on its ropes. When the bucket top rises to the surface of the water the counterweight reaches the vertical incline strut. As the bucket continues to rise the counterweight descends abruptly, throwing its full effective weight on the hoisting line, thereby relieving the engine of the extra weight in the air until the bucket again dips into the water; at this point the counterweight slips from the vertical to the incline track, eliminating its tension upon the hoisting rope.

The lower counterweight track is extended aft from the foot of its vertical hoist, hence it can remain in equilibrium at the bottom of the dredge for inspection or adjustment. By this arrangement and the location of the hoisting engine, the counterbalance is always effective and the bucket can be operated at full radius on either side of the dredge.

This dredge, which is about one-fourth smaller than other dredges of equal capacity, has been designed by H. Toomey, and built by Toomey Bros., New York.



Showing Placing of Machinery on 50-Foot Dredge

Iron Ore from Spain and Sweden

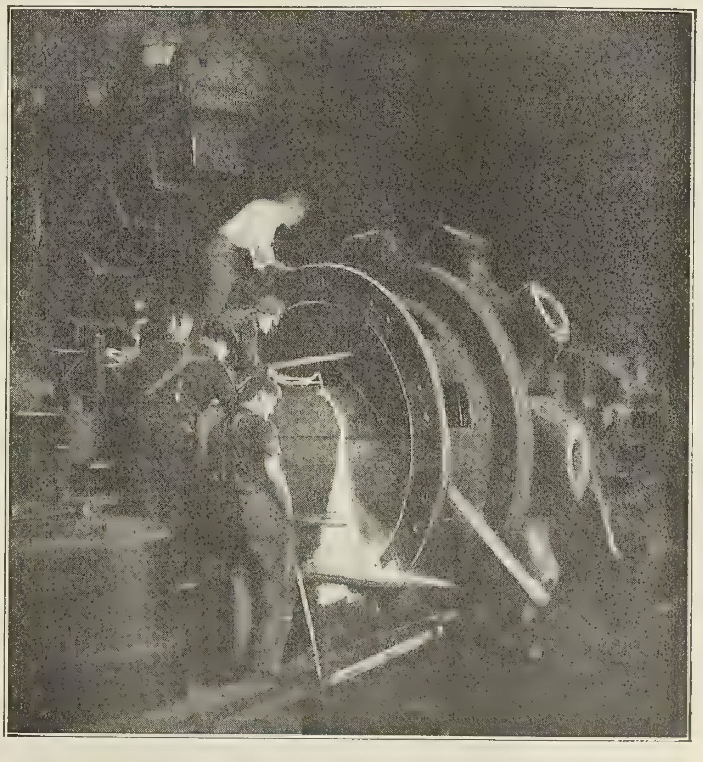
The War Trade Board announces in a new ruling that, in addition to the license covering the importation of iron ore from Sweden and Spain when coming as ballast in ships returning from those countries, licenses may be issued for the importation of a maximum total from all sources of 70,000 tons of low phosphorus iron ore from Spain, Sweden, Norway and North Africa, provided the ore be imported and entered prior to July 1, 1919.

Annual M. E. B. A. Meeting

The Marine Engineers' Beneficial Association will hold its annual convention in Buffalo on January 20-25. "This will be the biggest convention in the history of our organization," said President Brown. "All of our national and district officers will be there, besides delegates from all ports, and several of our members who now hold commissions in the United States Naval Reserves and probably some men distinguished in Government circles. The M. E. B. A. has done much to help win the war, and we are going to make the coming convention an occasion of general jollification over the great victory."

A Job of Heavy Shaft Cutting

For the quick removal of steam pipes to make room for turbine generator sets, a heavy shaft-cutting job was recently put through in a large power house by the cutting equipment of the General Welding & Equipment Company, Boston, Mass. Several 36-inch shafts had to be cut. The cutting was made particularly difficult because of the 26-inch solid steel which it was necessary to penetrate before reaching the inner hole of 10-inch thickness. The illustration shows the "Bulldog" cutting equipment satisfactorily "delivering the goods."



Cutting 36-Inch Steel Shafts

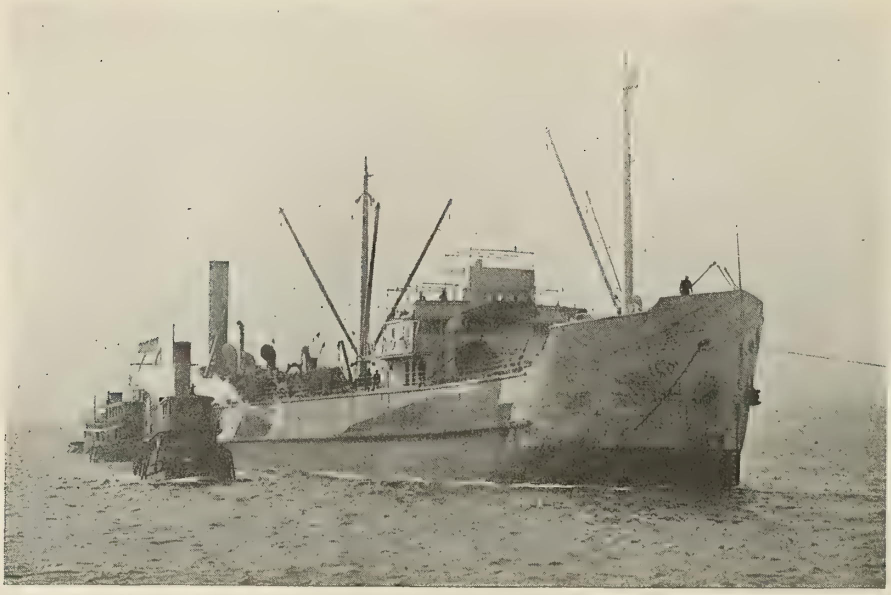


Fig. 1.—Concrete Ship *Faith* Coming Up New York Bay

Concrete Ship "Faith" Reaches New York

The *Faith*, launched in March, at Redwood, Cal., arrived in New York on November 21. Her success was first proved on a trip to Puget Sound, when she weathered a severe storm. Later she carried cargo to San Francisco, then to Peru. She then returned with a cargo of nitrates to New Orleans through the Panama Canal, and now comes from Cuba with a cargo of sugar.

Fig. 2.—Deck of the *Faith* Under Inspection at New York

After discharging her cargo she will be in drydock for inspection and survey. There is great interest among the concrete shipping interests and the members of the International Concrete Ship Association in the East, who have been invited to the inspection. They believe that the very satisfactory results will prove entirely convincing to the shipping world in general as to the practicability of the concrete ship.

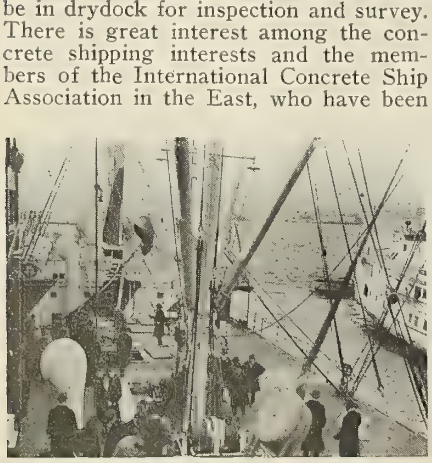


Fig. 3.—Another View of Concrete Deck

PERSONAL

George T. Fonda has recently been appointed general supervisor of Employment, Compensation and Welfare for the Bethlehem Steel plants located at Bethlehem, Steelton, Lebanon, Maryland, Detrick & Harvey and Titusville. In this capacity he will be attached to the office of Vice-President Bent. As organized the department will serve as a clearing house between the different plants.

Professor C. C. Lorentzen has recently been appointed director at the Marine Engineering School of the Ocean Association of Marine Engineers at 15 Whitehall street, New York City. As a graduate of the Royal Danish College for Shipbuilding and Marine Engineering, Copenhagen, and with many years' experience in connection with the Danish navy, Professor Lorentzen is well fitted for this important position. Professor Lorentzen has also served as professor in the School of Applied Science, New York University, as head of the Department of Mechanical Drawing and assistant in the Department of Experimental Engineering.

C. T. Henderson has resigned his position as chief engineer of the Submarine Boat Corporation, Port Newark Terminal, Newark, N. J., to become chief engineer of the Hercules Engineering Corporation, 501 Fifth avenue, New York City, also acting president of the Electrolytic Engineering Corporation at the same address.

L. E. Shumacher, who for the last eight years has been chief inspector at the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., has taken the position of works manager of the Krantz Manufacturing Company, Brooklyn, N. Y., the latest subsidiary of the former company.

OBITUARY

Bernard Nadal Baker, of Baltimore, retired capitalist, shipping expert and a former member of the Shipping Board, died in Los Angeles on December 20, after an illness of three days. Mr. Baker was president of the Atlantic and Pacific Transport Company, formerly president of the Baltimore Trust and Gurantee Company, and a director in many commercial enterprises. He was also one of the moving spirits in the creation of the Shipping Board.

BUSINESS NOTES

L. F. Body, formerly with the Master Builders' Company of Cleveland, Ohio, has joined the sales organization of the Glidden Company, Cleveland, as manager of railways, street railway and marine sales.

L. C. Sprague, who has been appointed assistant secretary of the Chicago Pneumatic Tool Company, has established offices at 52 Vanderbilt avenue, New York.

Hamilton & Chambers, 29 Broadway, New York City, have been retained as consulting engineers in the building of the new drydock for Providence, R. I.

Joseph T. Ryerson & Son, of Chicago, have opened an office in the Widener building, Philadelphia.

Hayden F. White, who has represented the Independent Pneumatic Tool Company, of Chicago, in the Detroit, Chicago and Milwaukee districts for some years past, has opened a branch office at 1103 Citizens building, Cleveland, Ohio.

The Brown Hoisting Machinery Company announces the following changes in its organization: Harvey H. Brown, chairman of the board of directors; Alexander C. Brown, president; Melvin Pattison, vice-president, general manager and director; Robert G. Clapp, director; John F. Price, director, and Ewen C. Pierce, general manager of sales.

William N. Kinney has been appointed general manager of the Portland Cement Association, Chicago, Ill.

Following the special meeting of the Pratt & Cady Company, Hartford, Conn. held on Monday, December 2, the official personnel of the company now comprises: W. B. Lashar, president; B. I. Ashmun, vice-president and general manager; E. L. King, secretary-treasurer; O. L. Beach, assistant secretary; A. E. Oldroyd, assistant treasurer. The company recently purchased the property and business of I. B. Davis & Son, and will continue the manufacture of feed-water heaters, hot water generators and power pumps.

Fairbanks, Morse & Company, Chicago, Ill., announce the following changes in personnel: R. H. Morse becomes vice-president, in charge of purchasing and traffic, retaining his position as director of the company; C. W. Pank becomes vice-president, in charge of sales of all factory products; W. S. Hovey has been elected vice-president, in charge of general manufacturing at all factories, and W. E. Miller becomes treasurer in place of F. M. Boughey, now secretary and comptroller.

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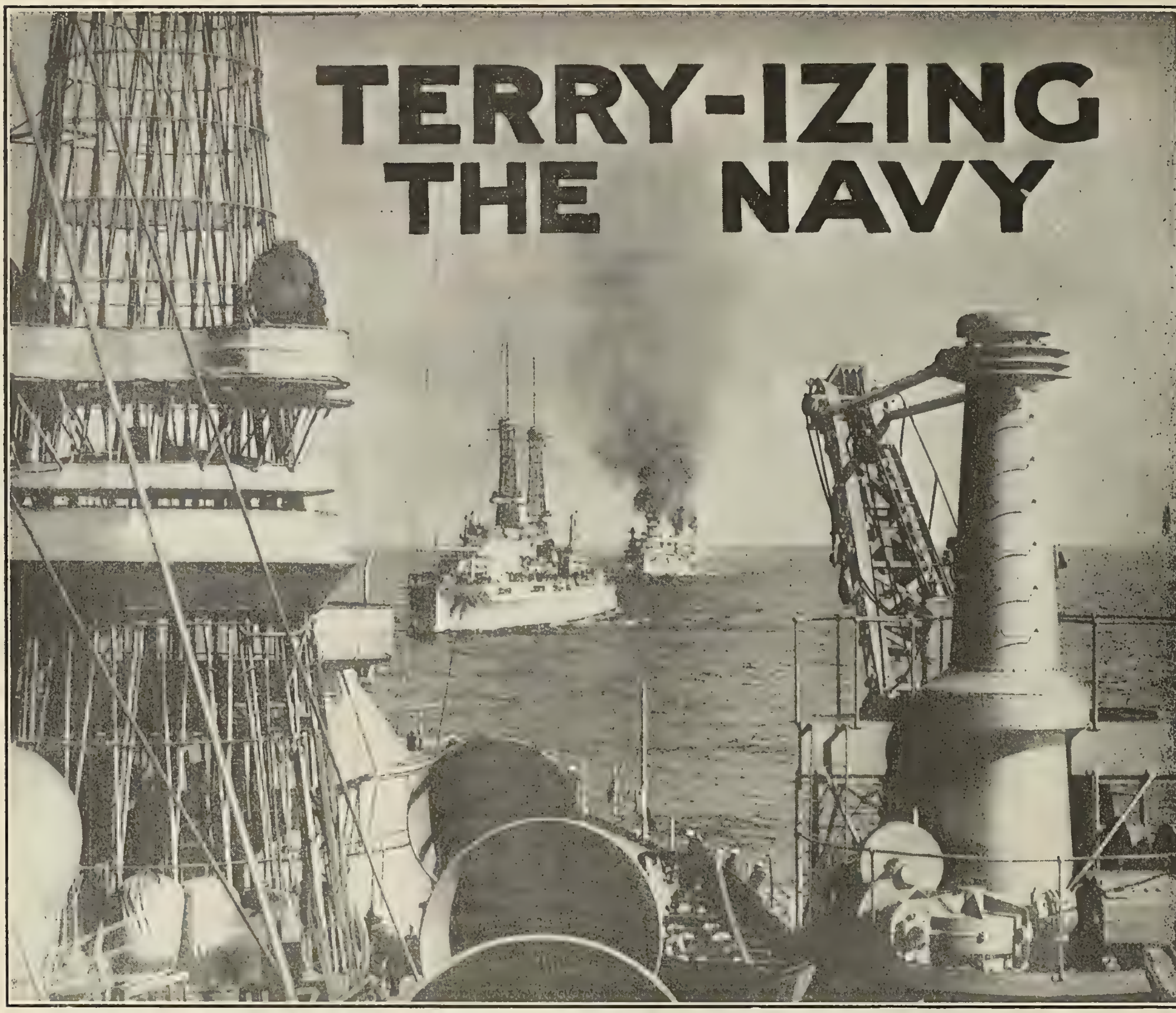
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Build Up the Merchant Marine Under Private Ownership

EXCEPT for occasional utterances from Administration circles, scarcely a voice has been raised in favor of Government ownership and control of the American merchant marine. The shipbuilding and shipping interests are unanimously opposed to it. Their opinion is based upon years of experience with the intricate problems involved in building and operating vessels for domestic and foreign commerce, and is further borne out by the experience of most foreign countries in maintaining merchant fleets in competition for the world's trade. In view of this general attitude with regard to the most feasible method of building up and maintaining the American merchant marine, why should further consideration be given to the question of Government ownership? This matter should be definitely settled and plans immediately developed for building up the merchant marine under private ownership.

Raise the Ban on Foreign Contracts

FRANCE is in the market for about 2,000,000 tons of merchant vessels. Great Britain, Italy, Norway and other maritime nations are ready to place contracts for cargo ships wherever the opportunity offers. American shipbuilders, meanwhile, are prevented by an order from the Shipping Board from accepting contracts for vessels from foreign owners. It is true that for the time being American yards are well supplied with work from the Government, but the future, especially for the newer yards, which have been constructed solely for carrying out Government contracts, is clouded with uncertainty. With the probability that Government orders will be curtailed to a certain extent, there is every reason for giving American yards the opportunity to secure foreign business and keep their plants occupied to maximum capacity for months to come. It is only by operating at full capacity that these yards can keep up the high standard of efficiency necessary to reduce the cost of production.

A Way to Meet Competition

IN a recent statement, Edwin C. Bennett, vice-president and general manager of the Newburgh Shipyards, says that in order to stay in business the American shipbuilders will have to come down to a competitive basis with the yards of Great Britain, and this can only be accomplished by one of three ways: First, to reduce the rates of labor as compared with those of Great Britain; second, to increase the output and efficiency of every man in the shipyards; third, to receive a subsidy from the Government. The most acceptable solution of this problem, he holds, is by the increase of output and efficiency of the men working in the yards. If the shipyard workers of America will turn out 33⅓ percent more work per day than the men in British yards, then the shipyards in America can hope to retain the present high standard of wages and yet compete successfully with the shipyards of Great Britain.

This solution of the problem puts the matter entirely up to the shipyard executives, workmen leaders and foremen. It is sound advice and should be carefully heeded by the men in every American shipyard. During the last year the yards on the Great Lakes turned out more tonnage per man than any other district in the country. Their work has been developed along the line of increasing the efficiency of the individual workers, and the results have been substantial and gratifying. This lesson could be more generally applied with profit.

Council of the Naval Architects' Society

LITTLE appreciation of the changed situation in the marine field is shown by the Society of Naval Architects and Marine Engineers in electing to its Council anyone who is not intimately associated with the building or operating of ships. In previous years, when shipbuilding was of less consequence, if it seemed desirable to elect certain members to the Council out of courtesy, little harm was done, but in these days, when the country is establishing a big merchant marine, the management of the Society should be in the hands of the most competent men available. The time has come when the Society should make its influence felt in laying out broad policies for the building up and maintenance of the merchant marine created by the war, and if the Society is going to do the work that it will be called upon to do, and do it efficiently, a radical change in policy will be necessary.

American Ships Built In 1918

DURING the calendar year 1918, American shipyards built 1,882 merchant vessel of 2,721,281 gross tons, as officially numbered by the Bureau of Navigation, Department of Commerce, including a small amount of tonnage built for the French Government. As compared with an output of 1,699 merchant vessels of 1,034,296 gross tons from American shipyards in 1917, a gain is shown of 1,686,985 gross tons, or nearly 165 percent for the year.

The seagoing tonnage for 1918 totaled 821 vessels of 2,597,026 gross tons. Of this, 460 vessels of 1,861,321 gross tons were steel steamships, the remainder being of wood. The non-seagoing vessels totaled 1,061 of 121,255 gross tons.

When the armistice was signed on November 11, American yards were approaching an average monthly output of 400,000 gross tons, including vessels which the fabricating yards were just beginning to produce in quantity. The cessation of hostilities, however, led to an appreciable reduction of effort through reduced overtime, canceled contracts and like incidents.

Lloyd's Report on World Shipbuilding

MERCHANT vessels under construction throughout the world at the end of September aggregated 6,371,388 gross tons. This includes 1,966 steam vessels of 6,258,194 tons and 178 sailing vessels of 113,194 tons. The figures are furnished by Lloyd's Register of Shipping for the quarter ended September 30.

The returns, which take into account only merchant vessels in course of construction in the United Kingdom, the British Dominions and allied and neutral countries of 100 tons and upwards, the construction of which has actually begun, show that there were 383 merchant vessels of 1,746,933 tons gross under construction in the United Kingdom at the close of the quarter ended September 30.

Economical Ships Will Win

DURING the war all efforts in the shipyards were directed to speeding up production and getting out the greatest amount of tonnage in the shortest possible time. Questions of economy of operation of the vessels were very properly made secondary to rapid construction, adequate supply of materials and manufacturing capacity, reliability of operation, maximum speed and carrying capacity. To gain these ends something was necessarily sacrificed in the economy of operation and durability of the vessels. The result has been that a part, at least, of the emergency fleet created by the war consists of vessels which, in efficiency and economy of operation, do not compare favorably with the merchant vessels of other nations.

These statements are not made with the object of criticising the work of the Emergency Fleet Corporation or of American shipbuilders, for criticism of what has been accomplished during such an emergency is, in our opinion, unjustifiable. The object of building the emergency fleet was to get our troops and their supplies to the front in the shortest possible time. The effort was honestly made, and if it failed in some particulars the results more than justified the attempt. The moral effect of the effort to build a bridge of ships across the Atlantic had a far-reaching influence upon our Allies, upon ourselves and upon Germany. The ends justified the means and the results speak for themselves.

But with the return of peace entirely different conditions affect the building of ships. From now on shipbuilders and shipowners will have to contend with worldwide competition in building and operating vessels. Legal restrictions and adverse legislation cannot be overcome by improved ship design; a revision of the navigation laws and a change in Government policy regarding shipping will be necessary for that. But when these obstacles are removed the fact remains that, other things being equal, the success of American ships in competition with foreign vessels will depend upon the ability to operate these ships as economically from an engineering standpoint as the ships under foreign flags.

This puts the success of American shipping squarely up to the naval architects and marine engineers. Figured on a basis of fuel consumption, speed and deadweight carrying capacity, American vessels must hold their own against the best of the world's shipping. The chairman of the Shipping Board realizes this, and in recent addresses has emphasized the need for giving greater consideration to the question of economy in operation of vessels rather than to speed of construction. Further than this, the Shipping Board has already appointed a committee of men identified with large and successful shipping enterprises to examine the building plans of the Emergency Fleet Corporation to consider what revisions of types of vessels are advisable and what modifications of plan or practice can be undertaken to give the Fleet Corporation's output of ships as high an economic value in world trade as possible.

As something like 20,000,000 tons of coal will be required annually for operating the new emergency fleet, it is of vital importance that this item of operating cost be materially reduced. Again, the reports of machinery trouble on the emergency vessels which have been current in recent months show that there is an opportunity for both naval architects and marine engineers to attack the situation in earnest and assume the authority that is theirs by right to control specifications and construction details. From now on, economical operation of the ships should, and must, be required from those in authority. The excuse will no longer be valid that lack of time or material prevents attaining satisfactory operating economies.

Belfast's Extraordinary Shipbuilding Records

WHEN British shipowners were told that shipbuilders in Belfast are building standardized ships in half the time required by shipbuilders in England or Scotland, the shipping fraternity rubbed its eyes in amazement. The Ulster capital, it seems, completes a standardized ship in twenty-four weeks from the time the keel is laid, whereas Stockton requires forty-one weeks, South Shields and Hull forty-four, Sunderland forty-seven and forty-eight, and Glasgow fifty-four and fifty-five. If the difference were a matter of only a week or two as compared with the time required in the Clyde yards, it might be accounted for in several ways, but when Belfast shipbuilders are turning out the work in half the time of their competitors, there must be some unusual reason to account for it.

First of all, there is no conscription in Ireland. The Belfast yards have even more labor than before the war. On the other hand, on the Clyde, Tyne, Tees and other British rivers there has been a veritable famine of skilled labor. Some of the best men have been in the army, and extraordinary inducements have failed to lure them from the tenacious clutches of the War Office.

A good many people have also jumped to the conclusion that either Belfast workmen must be extremely industrious or that the shipyard workers on the Clyde and Tyne are not doing their best. Of course the figures prove nothing of the kind. But it would be interesting to learn in connection with the work in the Belfast yards how much preliminary work is being done on the ground before the keel is laid. Firms with plenty of space and ample supplies of labor do more preparation on the ground than firms short of space and labor can do.

Then, again, the question of cost arises. The four features determining the cost of a ship to the purchaser are: Material, labor, establishment charges and profits. One would expect that Belfast, with its accelerated output, would be building these ships more cheaply than any of its competitors. But this is not so, the reason alleged being that its labor is more costly per ship. As a matter of fact, the North East of England builds cargo vessels, standardized or otherwise, more cheaply than any other shipbuilding center.

Taking all things into consideration, perhaps it is not so surprising that yards which can keep their organization intact, retain their own workers, pay good wages and provide facilities for completing much of the work before the erection of the vessel is begun can make an unusual

showing in quick deliveries. The Belfast yards, apparently, have been fortunate in many respects at a time when others have had extraordinary difficulties to overcome.

The Wooden Emergency Fleet

CHARGES recently made in the Senate, to the effect that the wood ship programme of the Shipping Board has been a complete failure and that all money invested in these vessels will be a dead loss to the Government, have brought out a statement from James O. Heyworth, manager of the Wood Ship Division of the Emergency Fleet Corporation, which summarizes the progress in the construction of the wood ships and gives some idea of the results obtained in their operation. Measured by performance, which includes vessels under way as well as vessels delivered, Mr. Heyworth asserts that the entire wood shipbuilding programme has shown an efficiency of 72½ percent. Up to December 1, 101 wooden ships had been completed, of which 94 are in active service. Facts are now available concerning the movement of 85 of these vessels. In all, they have made 305 voyages covering a total of 490,422 statute miles. The record shows that 194 of these voyages were with cargo, representing a freight movement of approximately 485,000 tons, a total mileage of 391,092 statute miles. The vessels have been active in the Atlantic and Pacific coastwise trade, they have traveled to the Hawaiian and Philippine Islands, to South America and to Africa. This movement of cargo has been accomplished with substantially no loss to the shippers. It has thus been demonstrated that the vessels of the wooden fleet have rendered valuable service in both coastwise and trans-oceanic runs.

As to the many rumors of general failure of this type of ship and the specific charges made in the Senate, Mr. Heyworth declares that the Emergency Fleet Corporation has a wealth of evidence on hand concerning the staunchness and seaworthiness of these vessels—evidence that is sufficient in volume and character to emphatically disprove any rumors of general failure on the part of the wooden fleet. It is true that expectations as to deliveries were not met. Delays occurred from the start; first, in preparing the designs of the vessels; second, in securing materials; third, in equipping the yards, and fourth, in securing the machinery and fitting out the vessels. Other handicaps included poor railroad service, bad housing conditions and inexperience among contractors. But in spite of these delays the output of wood ships proved sufficient in amount and early enough in time of delivery to be a factor in solving the transportation problems of the war. Taking all things into consideration, Mr. Heyworth believes the construction of wooden ships was justified both by the conditions existing when the wood ship programme was decided upon and also by the account which these vessels have given of themselves in actual service.

Of the troubles experienced with the ships in operation, 90 percent were of a minor character, according to Mr. Heyworth's statement, and of these one-half were probably due to inexperienced crews or faulty handling. In refutation of the charge made in the Senate that "none of the wood vessels delivered has yet gone overseas because none is fit to go," the fact is cited that the wooden vessels of the Emergency Fleet carried substantially an entire sugar crop from the Hawaiian Islands in 1918 without any greater damage to this highly perishable cargo than is sustained in steel ships. Practically all of the canned goods originating in the Islands have been transported to the American Pacific and Atlantic coast ports with similar results. In order to eliminate so far as possible the minor mishaps on the newly-built wooden vessels, 24-hour deep-sea trials of all new wooden steamers were inaugurated by the Government officials in the Oregon district in the latter part of November. Before entering on their 24-hour sea trials the vessels are put through a dock trial and then taken out for a 6-hour run in sheltered waters, so that by the time they go to sea for the final test the necessary adjustments have been made and the vessels can be promptly released for commercial purposes. At the present time the Shipping Board is ready to charter its wooden steamers on time charter for service within approved limits.

Help Place Army and Navy Officers and Men in Civilian Trades and Professions

AMERICA'S greatest assets, the brain power and energy of her thoroughly trained young men, are the commodities in which the professional division of the United States Employment Service are now dealing. Officers and men of the Army and Navy released from active service are being registered with the division and placed in touch with those employers who can best make use of their services.

This division deals only with those men who are well equipped by education and experience in their particular lines of work. The record of each man is carefully investigated before registration is permitted. Many university graduates in mechanical, electrical and civil engineering, and in chemistry, and other technical men with several years of practical experience, have already been registered. These men who willingly severed their business relations more than a year ago to give their services to their country are returning to civil life to find changed conditions.

Although the industry of the country has great need of their services, neither men nor employers are able, without assistance, to discover each other immediately. To avoid delay in the readjustment processes, not only the labor of the country but also the highly trained directors of industry must be mobilized. The aim is that each man shall fit into that part of our business organization in which he can do his best work.

The task of dealing with thoroughly trained men who, in many instances, can command high-salaried positions requires the assistance of those technical organizations which have heretofore placed university graduates and experienced men with employers. The professional division, therefore, is seeking to co-operate with all such societies by referring properly qualified men to them or by obtaining from them data on positions available.

The technical engineering field appears to present the largest problems of the professional division, since thus far nearly one-half of all the applicants have been qualified for work in various forms of the engineering profession. Temporary lull in general construction work has in part closed one field which, it is believed, will be more available by the time the overseas forces begin demobilization on a large scale.

At the professional division of the United States Employment Service, with New York office at 16 East 42nd Street, registrations of experienced men are increasing. Employers seeking such men are asked to inform the professional division of the precise nature of the positions which they have available. Only those men who are well qualified to fill such positions are referred to the employer.

Standardization in Shipbuilding

In the efforts of the British Government to cope with the urgent need for an increased output of shipping, the standardization of the auxiliary and propelling machinery for merchant ships naturally followed upon the adoption of the policy of building standard hulls. It was considered that the best method of securing rapid output was to adopt the tried design of firms accustomed to producing the merchant ship class of machinery and to appoint one firm to act in a leading capacity for each different size of machinery. That is to say, all the designs for each class of engines, with the exception of the small pumps, etc., were prepared by one firm and issued complete to the various machinery contractors, together with a specification of all the raw material and finished items which were to be obtained from sub-contractors.

The drawings and information issued by these leading firms were very complete, much more so than usual, so that even firms who were not familiar with such work would have no difficulty in knowing exactly what was required. In this way the labor in other drawing offices was reduced to a minimum. As all firms are working to one design, it has been arranged in many cases that firms do not make new patterns, but obtain the use of those already made by another firm, thus reducing labor and conserving the special timber required for pattern making. With standardization, materials, such as shafting, auxiliary machinery, pumps, valves, fittings and piping, can all be manufactured in large quantities and thus the fullest advantage taken of duplication and of the available reserve in plant and labor. Moreover, in the event of a firm falling behind with the construction of machinery for a particular hull, a replace set can easily be transferred from another source. The delay in completion that must have been incurred had each builder been building to his own designs and sizes is therefore avoided.

The first size of machinery adopted was capable of developing about 2,500 indicated horsepower under normal conditions, and about 3,000 horsepower for a short period in an emergency. The standard designs adopted were prepared and issued to the machinery contractors within a few weeks after the instructions were issued to the leading firms, and the first vessel fitted with standard engines was ready for sea eight months after the order for her was placed. The programme has now been extended to include larger vessels with greater power, and also smaller vessels down to the coaster size. Even so, however, the number of different types of engines constructed has been kept down to the minimum. They do not exceed half a dozen.

Experience has now proved the very real advantages of standardized machinery. For instance, engines and boilers have frequently been transferred from one firm to another, in order to expedite delivery. Again, in many cases where engines and boilers have been damaged by enemy action in the war they have been replaced without loss of time by standard engines and boilers ready to hand, thus greatly expediting the completion of repairs, which would have taken longer if it had been necessary to await the construction of a new engine and boilers. In many cases, too, a part of an engine has been sent from one firm to another to expedite the completion of a particular set of machinery.

Another very great advantage accrues from the standardization of the smaller parts of machinery. As each of them is reproduced without the slightest variation, the sub-contractors can work continuously and produce them in large numbers. There is, therefore, no delay in delivery when they are needed, whereas with the old methods, although such parts differed only in very small points, to suit the needs of individuals the difference was sufficient to prevent their use for the first firm requiring delivery.

Perhaps one of the most important advantages of the standardization of merchant ship engines is that it has enabled the labor and equipment of a number of inland firms to be utilized in a manner which would not otherwise have been possible.

LETTER TO THE EDITOR

Analysis of Shipyards Organization

In reply to Mr. Frederick Thorne Warner's letter in the January issue on "Analysis of Shipyards Organization," I will take up the points in his letter in the order in which they occur.

The pipefitters should be under the machinery superintendent, as pointed out by Mr. Warner, and in addition to this change I would put the riggers under the hull superintendent and not under the machinery superintendent as they appeared in my first article.

The painters under the plant engineer were put there deliberately, and there is no reason why they should be confused with the ship painters.

On the schedule of information called for by the Emergency Fleet Corporation from prospective contractors, plant facilities for producing work are put ahead of housing problems for the men. Therefore it seems to me a debatable question whether "social entertainments" for workers should be called one of the more important functions in the "service or industrial relations" department, when this department is called by Mr. Warner "the most important department in modern shipyards."

The "superintendents' department" was not omitted from my article, as Mr. Warner insinuated. This department was mentioned in my summary and conclusion on page 617 of the November, 1918, issue of this magazine.

The duties of the chief engineer and the naval architect have, to the best of my knowledge, never been successfully combined. Each man should be a specialist in his own branch, and naval architecture and marine engineering are two very different branches of engineering.

I do not believe that the plant engineer should be put under the general superintendent of ship construction. At least it is not customary to do so in the old-established shipyards of the country where the present organization and work is based on twenty or more years of practical experience in the economic production of ships.

Under the heading "General," I have been criticised for having too many departments and too many divisions under departments. It is well known in logical reasoning and logical analysis that facts are most readily and most surely arrived at by division and subdivision until finally a point is reached where no further division is possible. If this method of analysis is followed out, as was done in my article, a great many of the mistakes that occur may be avoided and the shifting of responsibility for mistakes by the guilty department to some other department may be quickly detected and dealt with.

As there are several department heads who manage their own departments, as mentioned in my article, I fail to see where my reasoning was wrong in putting a general manager at the head of my organization.

Mobile, Ala. G. F. S. Mann, B. S.

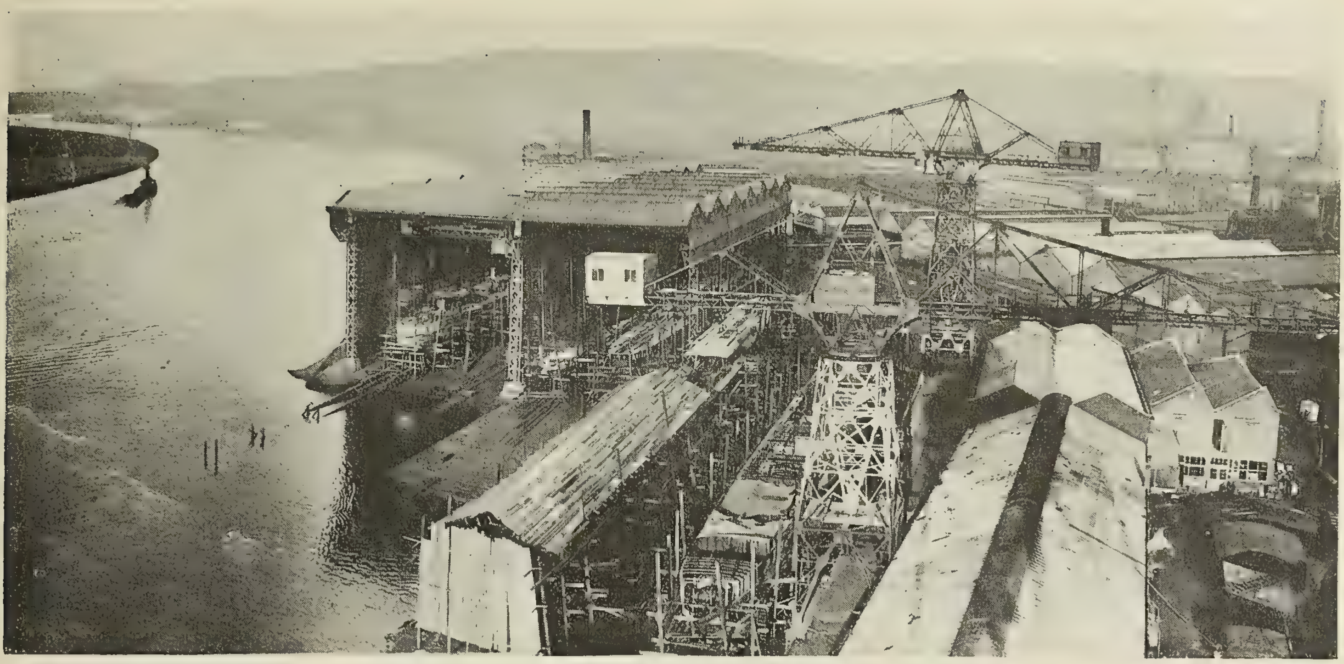

Fig. 1.—A British Shipyard Viewed from One of the Cranes

Some Things I Saw and Heard in England and France

BY H. L. ALDRICH*

FIFTEEN publishers and editors of leading American technical and trade journals received formal invitations from the British Ministry of Information to visit England and the battlefields of France as guests of the British government. The invitations were dated October 16, and the writer had the honor of being selected to represent shipbuilding and shipowning interests.

What made the invitations a very special honor is the fact that hardly more than fifty civilians in all the allied countries have seen, heard and experienced as much regarding the great war as this wonderful opportunity enabled us to do during these many eventful weeks. Neither in the invitation, nor in any subsequent communication, did we receive any definite explanation from the British government, or its representatives, as to why we were invited; nor any hint whatever as to what it desired us to state or publish about the trip on our return. We can only surmise that the hope and expectation was that we had but to observe at first hand the actual conditions to realize and to testify that continued and unbroken friendly relations between America and England are necessary to guarantee a lasting peace.

Cordiality of the British

While in England we were entertained with the greatest of courtesy, and presented to many of the eminent men. In the twelve visits that the writer has paid to England, he has never found the Britishers more cordial in their manner, nor more eager to have the relations between America and England as close as possible. At the many dinners, luncheons and receptions, English speakers expressed the warmest admiration for America and its institutions and the keenest appreciation of this country having come into the war, and having done its part in helping to end it.

* President and Treasurer, Aldrich Publishing Company, New York.

It was apparent to us that the English people are exceedingly anxious about two things: First, the building of so many ships here leads the Britishers to feel that possibly America may be England's rival as a shipbuilding and a ship-operating nation; second, the loss of such a large proportion of their valuable men by the war, coupled with the enormous taxation, causes the fear that England may fall to the second position as an exporting nation. In talking with representatives of the government and of the great industries, and in visiting the shipbuilding center on the Clyde, I came to the conclusion that it is not improbable that America will become the great builder of merchant vessels for carrying the trade of the world from now on. This is possible because of our facilities for building ships, our freedom from enormously burdensome taxation, our cheaper materials, and our methods of "manufacturing" ships. But when it comes to great passenger vessels, there seems to be little doubt but that England will hold the lead in this direction.

So far as the export trade is concerned, I doubt if England will slip back to any great extent in her command of the foreign trade of the world, because she realizes the great importance of straining every effort to get her industries running at once in order to furnish employment for the working people. These industries will feel for some time the loss of many expert men by the war, but we learned that women are doing excellent work in nearly all branches of engineering. Certainly there is plenty of room in the world for two great shipbuilding nations, as well as for two great nations each bidding for the foreign trade, and any competition there may be between the two English-speaking nations will be a far fairer competition, and a competition more acceptable to the world that when Germany exercised her overbearing domination.

When I published the first issue of MARINE ENGINEER-

Fig. 2.—The Harbor of Saint Nazaire

ING in April, 1897, I firmly resolved never to allow any article to appear in its columns that did not appeal directly to the business interests of men connected with the designing, building and operating of vessels, but I feel that here is an occasion when I may venture to deviate slightly, and I use what I have written here as a peg upon which to hang a few statements as to what the members of our party saw and heard when visiting the battlefields of France. Many things have been published, some of which were based on correct information and others merely on hearsay, but I will simply mention some of the things we saw with our own eyes or heard from men whose veracity admits of no doubt.

We visited a score or two of cities and towns that were completely ruined. These include Ypres, Bethune, La Bassee, Albert, Bapaume, Lens, Menin, as well as many smaller towns. In a number of these places there was not a building, nor even a room, where a man could find shelter from the rain. No words can describe the horrible destruction of houses and other buildings which had been reduced to nothing more than a mass of rubbish. We passed a score or so of sites of towns where there was no indication that any town had once been there, excepting that there were big signs announcing that this was the site of such and such a place. Not only had all buildings vanished, but all traces of roads and streets were obliterated.

We passed tens of thousands of acres of land torn up by shell fire, the craters encroaching one upon another, so that it is really dangerous to attempt to walk there for fear of falling into a crater. These craters are usually full of water and of varying depths, most of them being over the head of the tallest of men. Throughout this blasted land there are vast numbers of unexploded shells and the rotting bodies of thousands of dead soldiers.

The general impression seems to be that for several generations this land cannot be utilized, unless for the purpose of planting a special kind of tree, which may help to restore it. The neighborhood of Lens was one of the great coal mining centers of France with a very large population, yet not a building remains that is not beyond reconstruction. Here we saw the most pathetic sights of our trip, such as a young woman and her mother standing in front of a heap of rubbish where there had once been a home. They were holding hands and looking fixedly at this nothingness, with a pitiful expression of hopelessness, as the tears rolled down their faces. The glimpses we had into the core of human anguish tore at our souls even more than did the desolate scenes of devastation.

French Cities in Ruins

In Arras the great cathedral was in ruins, as was also the greater part of the city, only a few houses in the outskirts remaining intact. Around the cathedral and in two of the squares there were signs reading, "This space has been preserved by the French authorities as an historic feature and a permanent memorial."

On the roads we passed thousands of Hun prisoners, many of them quite young, and most of them with sullen, brutal faces.

Fig. 3.—Street Outside of the Cathedral, Arras

Fig. 4.—Ruins of Main Street, Combles

Fig. 5.—Ruined Ypres as it Appears Today. Interior of the Cathedral

Fig. 6.—Interior of Arras Cathedral Taken from the Eastern Altar

One of the many places that showed the cruel and beastly character of the Huns was Douai. This had been a prosperous little city of about 20,000 population. It was in the hands of the Huns up to a few weeks before the armistice. One evening at five o'clock notice was sent out that every man, woman and child must be out of the city before five o'clock the next morning. Then the Huns started in with their characteristic thoroughness and looted apparently every building in the city. I walked for miles in the business and residential streets and there was not a single building where the doors and windows were not smashed. Everywhere we could look in and see pictures slashed beyond repair, and beautiful carved furniture —sideboards, tables, chairs—hacked with hatchets or other sharp implements beyond all possibility of restoration. Portable valuables had been stolen, and everything that could not be carried off had been destroyed.

We went through the house of a well-known representative of the international Red Cross. He was a physician and had one of the finest art collections in Douai. The Huns stole most of his best works of art and destroyed the rest. Also this house, like the others, had been disgustingly befouled by the brutes.

Conditions Among the Survivors

We had a conversation with a most saintly old priest who had remained in Douai all during the occupation. He told us of the shocking things that had happened in the cathedral and elsewhere in the city. He told us how the Huns had robbed his own private chapel of everything worth carrying away and demolished what was left. They even took his sacred vestments, flung them on the floor and befouled them. When the Allied commander discovered the condition of the city he forbade his soldiers to enter it and ordered hordes of Hun prisoners to clean up their own filth.

We were told by a representative of the Red Cross that in a nearby town, just over the border in Belgium, the Huns collected six hundred women in the public square three days after the armistice and stripped them of every article of clothing—even their stockings. These garments they carried off for their women in Germany. Another Red Cross representative, who was a physician, told us that in a nearby Belgian town, before the armistice, the Huns had seized every woman above fifteen to be repeatedly ravished by officers and men. The doctor said that to witness the suffering of these tortured victims was the most terrible experience in his life as a physician.

I talked with many Americans, both officers and men, especially after we reached France. They said that over and over again Huns had forced refugees to pass through a barrage, and many of them were thus killed. I was told by several men of our army who had been in Belgium that they had never personally seen children who had had their hands cut off, but that they had seen many children with great scars across their cheeks, caused by blows from the swords of Hun officers. There are towns where there is scarcely a woman over fifteen who has not been compelled to have a child by a Hun. The terrible treatment of women and children by the Huns is one of the most appalling things in the war; it is in line with their filthy habits and vicious natures. Yet in talking with two captains of the American Army who had been prisoners in Germany, I learned that the Germans resent being called Huns because "the Huns were savages." Our visit to the Hindenburg line was interesting, as it showed us the trenches, as well as the dugouts in which the Huns lived.

The Harbor of Saint Nazaire

As a change from battlefields, I spent a day at St. Nazaire and saw the wonderful work that American engineers have done in developing facilities on an immense scale for handling munitions and supplies of all kinds. What our army has done in France is a revelation, and it has been done by individual initiative and capacity, in spite of the great handicap put upon our officers and men due to incompetence and petty politics at home. Our engineers have done many things that were supposed to be impossible of accomplishment, and in a surprisingly short time. For instance, in St. Nazaire there were no places in which to store supplies. Our engineers, in an amazingly short time, put up 176 warehouses, each 50 by 400 feet, and four more 240 by 500 feet. Along the waterfront we have the finest facilities I have ever seen for handling freight—great numbers of gantry, locomotive and various other kinds of cranes and hoists. I came home prouder than ever of the fact that I am an American.

The battle at Chateau-Thierry, where the American marines and soldiers put up such a valiant fight, showed clearly that the end of the war was near. We have the testimony of many Huns that the collapse of the Hun

morale at that time was chiefly due to their terror at the accurate markmanship of the American soldiers. When row after row of Hun troops fell before the American well-aimed bullets, the vanquished invaders started on their run back to Berlin, and kept it up until the armistice was signed. Many Hun prisoners declare that they are coming to America as soon as possible after the war. Will Congress take notice of this situation? Our soldiers fear not.

Our soldiers are announcing that when they get home they are going to let the American people know how petty politics and incompetence at home have caused the unnecessary loss of thousands of American soldiers. Almost every officer, as well as soldier, I talked with was exceedingly bitter on this subject.

Excellent Work of American Soldiers

In spite of everything, our soldiers were wonderful! And one of the great outstanding incidents in the war is not only the fact that we managed to put two million men into France in such a short time, but that practically green American soldiers went fearlessly into battle and "licked" the Prussian guards, who considered themselves invincible.

I cannot resist recording the wonderful things officers and soldiers said about the noble work of the Salvation Army men and women, who were everywhere on the battlefields attending to wounded and dying, as oblivious of shot and shell as they would have been of flies. All officers and men also spoke in the very highest terms of the Red Cross.

British and French Saved the World

The world can never give sufficient praise to the British nation for the magnificent manner in which it carried on the Great War for over four years. The Navy saved the Allies from defeat in the early days of the war, and later the Army backed the Navy with true traditional courage. Nor did France fall behind in her duty. These two nations saved the world and kept it worth living in.

Just before leaving London to sail for home, the following letter was addressed to President Wilson, who was then in Paris:

WALDORF HOTEL, LONDON, Dec. 19.

DEAR MR. PRESIDENT:

The undersigned American citizens address you to further the sacred cause of human justice and right.

For days we have been passing over the battlefields and through the ruined cities and obliterated villages of Belgium and France. We are among the first American civilians to survey this area of desolation, and we have been profoundly moved.

The devastation and ruin wrought are not the work of one man or a group of men. They are the result of a system the policies of which have been executed with thoroughness by a willing people. The evidences of organized pillage and vandalism are on every hand.

Every law presupposes a penalty for its violation. The laws of nations that civilization has so painfully built up through the centuries have been wantonly violated for four long years. To fail to enforce these laws now would be tacitly to concede the power of repeal by the criminals themselves. These laws must be re-established. To our minds, the enforcement of complete restitution and reparation by the people of Germany and the punishment of the leaders and their guilty agents for the crime committed in violation of existing laws against piracy, murder and pillage will do more than anything else could to ensure that future laws made by agreement of the nations will be observed.

We are writing this to you knowing that the sentiments expressed would receive the support of all Americans could they see these things as we have seen them and hear the terrible evidence from the lips of the unhappy victims.

HENRY G. LORD, Boston.
ROGER W. ALLEN, New York.
ARTHUR J. BALDWIN, New York.
H. M. SWETLAND, New York.
SAMUEL O. DUNN, Chicago.
HERBERT L. ALDRICH, New York.
H. COLE ESTEP, Cleveland.
HARRY E. TAYLOR, New York.
EDWARD H. DARVILLE, New York.
HOWARD C. PARMELEE, New York.
FREDERIC F. CUTLER, Boston.

New Timekeeping System Smooths Out Difficulties in Pacific Coast Yard

A NEW time-keeping system, said to be the only one in use that gives each worker a daily receipt for his labor, thus obviating disputes, has been successfully put in use at the yard of the Pacific Coast Shipbuilding Company, on Suisun Bay, 35 miles east of San Francisco. The system has reduced pay window disputes 99 per cent, it is declared. It was devised by three of the company's force, L. H. Heacock, T. G. Flynn and L. H. Donnelly. When the plan was adopted the company's payroll was approximately 2,500 men, and has since increased.

The plan is described in the yard's paper, *Full Speed Ahead*, as follows:

"The new H-F-D system of time-keeping, originated by members of this company's staff and in force in the last few weeks, has not only demonstrated its effectiveness in making for accuracy and reducing complaints and disputes to the minimum, but has proven popular with the workers, winning recognition for its fairness.

"The plan was worked out, with much thought and the benefit of long experience, by L. H. Heacock, auditor; T. G. Flynn, counter foreman, and L. H. Donnelly, paymaster.

"The use of the duplicate card system evolved by the originators on a plan followed in no other yard gives a documentary record of time, valuable to the man in the yard or shop and the office, and has reduced errors to one per cent of the old ratio. Arguments and bother are virtually done away with.

"This plant is the only one in existence, it is believed, which has ever given the men a daily receipt for time worked, enabling the men easily to prove any shortage claim, by presenting the daily card, correctly made out.

"The men are given the receipt cards on checking in. Instead of the old-fashioned time keepers, the validating is done by time checkers, who write on each man's card the number of his job. Periods or hours actually worked are indicated by punching in columns provided on the card. The duplicate of each card, with identical markings and punches, gives the office its record.

"At the end of his shift, the employee turns in his half of the double card, keeping the other half for his own record. Those turned in are collected by the office and posted on a card giving the weekly record, which shows the man's full working history for the week, with any deductions.

"If there is a difference of opinion between the employee and the pay window, it is only necessary to put the man's card and the office card together: the punch holes will match and establish the correct record."

Plans For Hog Island Steel Cargo Ship

Design and Construction of Single-Screw Vessel of 7,500 Tons Deadweight Type—Cargo Space 380,000 Cubic Feet

THE specifications call for a single-screw, steel cargo vessel of the two-deck Type, with bridge, forecastle and poop. The length over all is about 401 feet, and the length at the load waterline 390 feet. The molded beam is 54 feet, the depth to the second deck 23 feet, and to the upper deck 32 feet. At full load displacement the draft is about 24 feet.

The vessel is designed for a deadweight capacity of 7,500 tons, the total displacement loaded being estimated at 11,200 tons. According to estimates, the weight of the steel hull is 3,100 tons; of the machinery with water, 460 tons; of the wood and equipment, 140 tons, and the total weight of the ship, light, 3,700 tons. There are 380,000 cubic feet of cargo space, and the gross tonnage is estimated at 5,400.

Propulsion is by single screw, driven by a geared turbine of 2,500 shaft-horsepower, supplied with steam at 200 pounds per square inch pressure from three oil-fired water-tube boilers, with a total heating surface of 9,075 square feet, operated under natural draft.

The main turbine is designed to operate at 3,600 revolutions per minute, driving the main propeller shaft through a double helical, double reduction gear at a speed of 90 revolutions per minute. With dry saturated steam at 180 pounds gage pressure at the throttle, a 28-inch vacuum referred to a 30-inch barometer in the condenser, the steam consumption of the turbine, when developing its rated horsepower, is guaranteed not to exceed 12 pounds per shaft horsepower. The vessel has a fuel capacity of about 1,100 tons, and, with an estimated fuel consumption

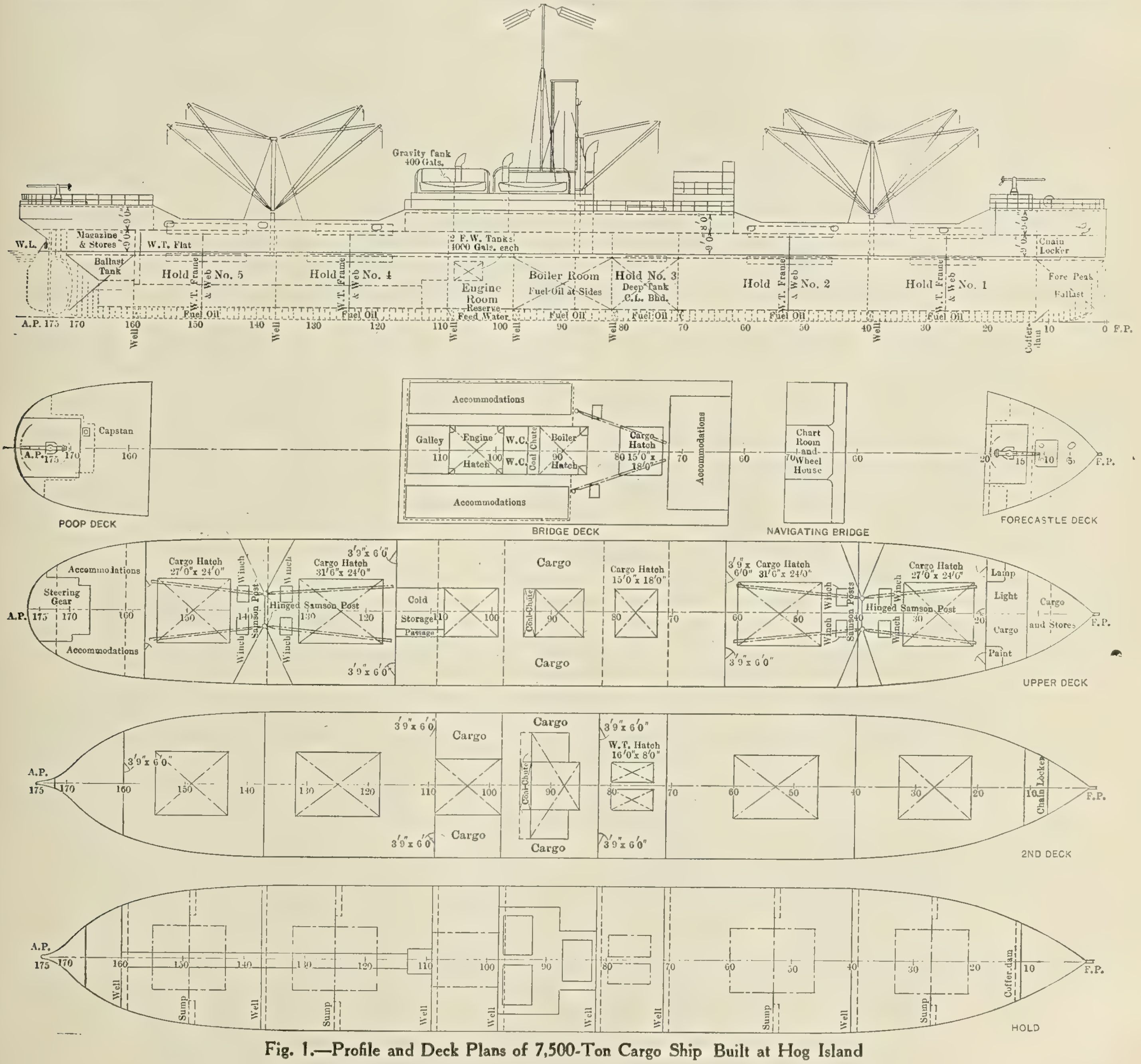

Fig. 1.—Profile and Deck Plans of 7,500-Ton Cargo Ship Built at Hog Island

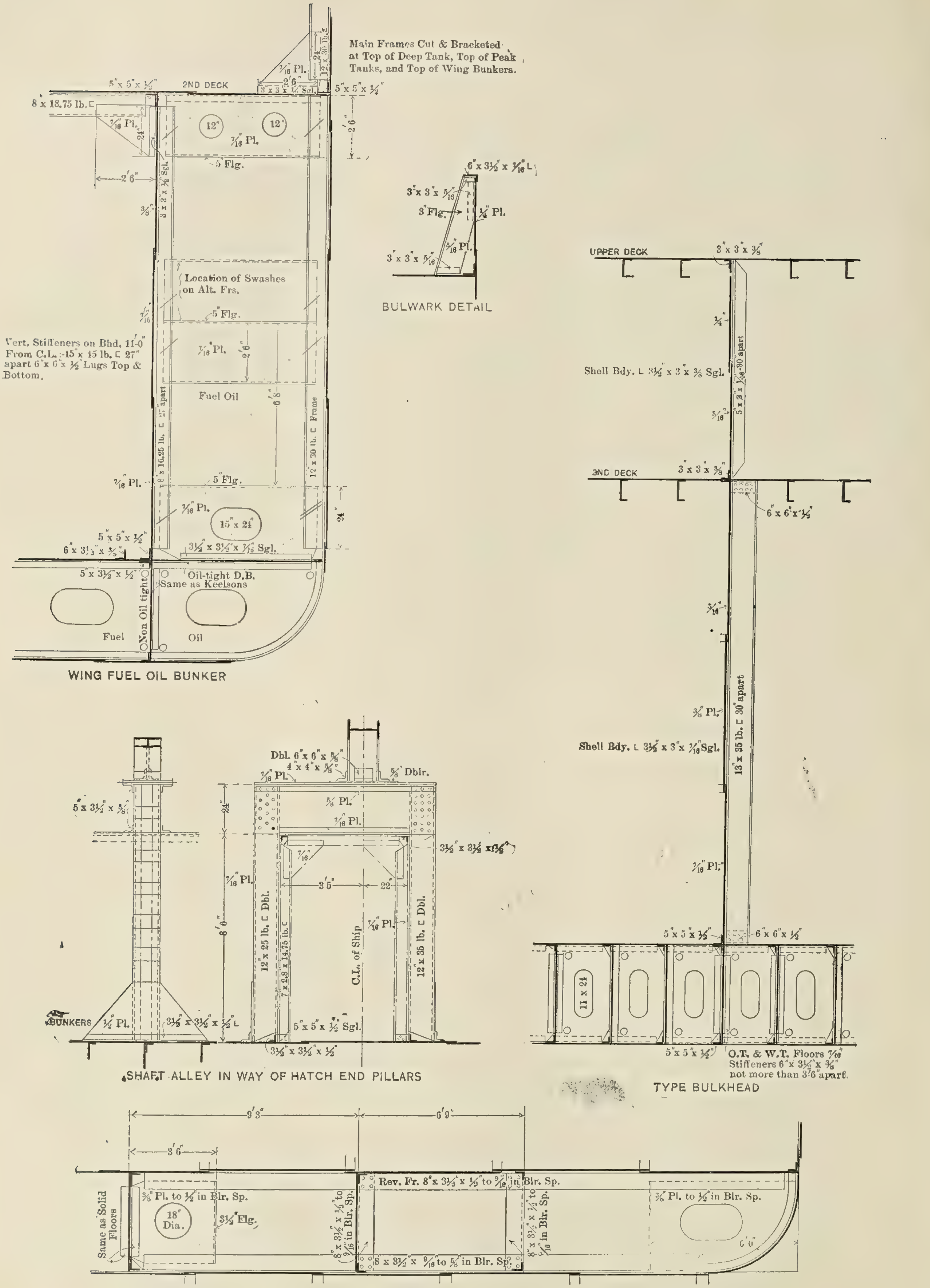

Fig. 2.—Details of Bulkhead and Tank Construction in 7,500-Ton Hog Island Ship

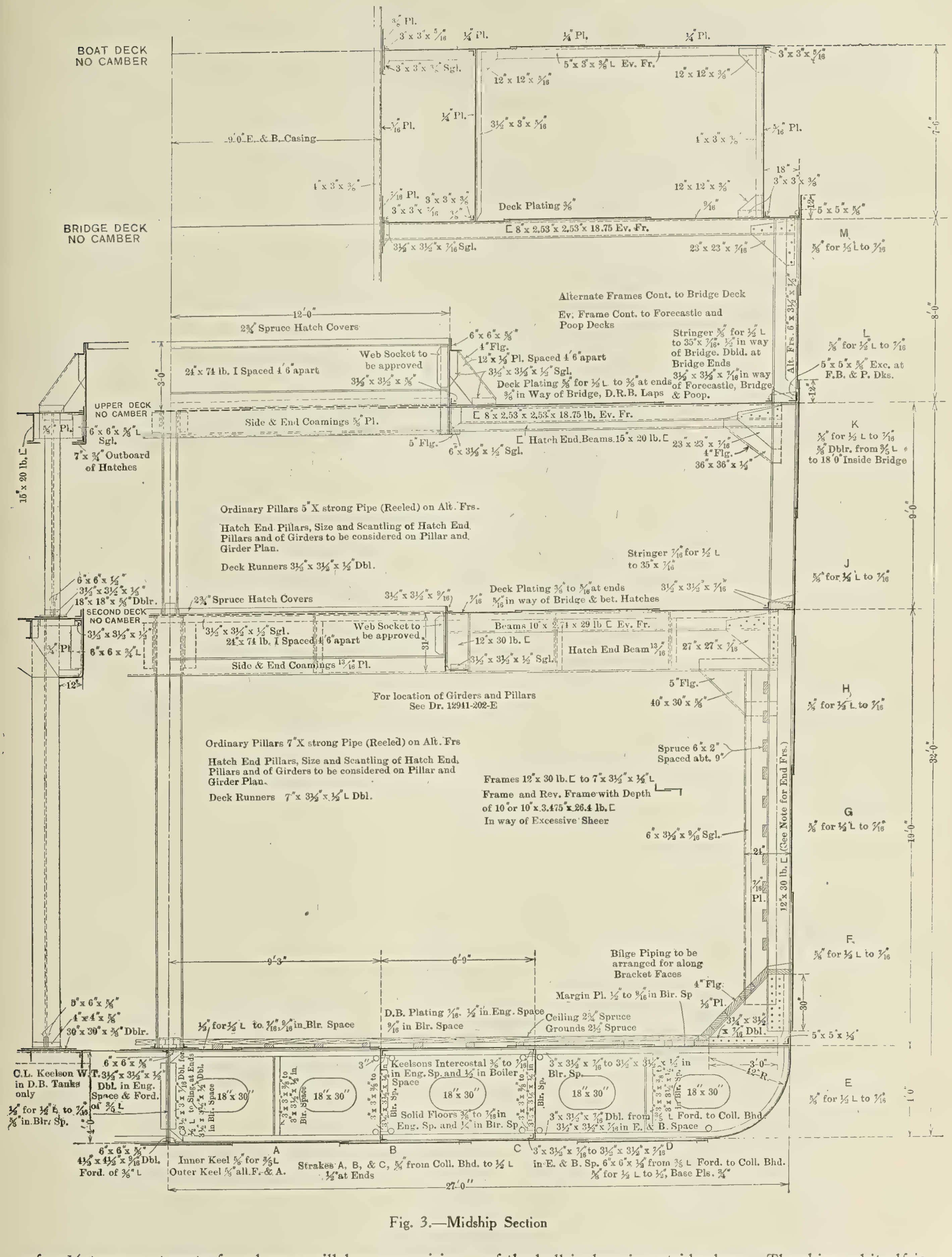

Fig. 3.—Midship Section

of 29½ tons per twenty-four hours, will have a cruising radius of over 10,000 nautical miles.

At the Hog Island yard practically all of the fabrication of the hull is done in outside shops. The shipyard itself is operated merely as an assembling yard, with sufficient shops and equipment to rectify the fabricating work

shipped into the yard which has been damaged, or for replacing parts that are needed. About 80 percent of the hull riveting is done in the yard, and only 20 percent in the fabricating shops.

The hull of the vessel is constructed on the transverse framing system and is subdivided into nine watertight compartments by eight transverse watertight bulkheads, all of which extend to the upper deck. There are four cargo holds served by five hatches in the upper and second decks and one hatch in the bridge deck.

Recent Developments in Shipyard Plants—I*

Concrete Building Slips for 1,000-Foot Vessels of 110-Foot Beam—Cranes Adapted to Special Needs—Well-Planned Structural Shops

BY NAVAL CONSTRUCTOR S. M. HENRY, U. S. N.

PRIOR to the demand for naval and merchant ships, resulting from the needs of the present war, there had been for a number of years little development in the shipyard plants. It was hard to make both ends meet, and very little money was left for expansion, either in the amount of shipbuilding equipment or in its character. In the last three years these conditions have entirely changed, and sums of money beyond the dreams of a few years ago have been provided with the view of increasing the number of ships that could be built, and of allowing the more rapid and less expensive construction of the larger vessels.

Of that class of development, which consists in providing for a greater number of vessels, we have seen the principal examples in the fabricating yards at Hog Island, Newark Bay and Bristol, though the increase in number of ways available has been by no means limited to these yards. Many ways have been added in other yards, and entirely new plants have been built up.

The second general line of development has resulted in providing bigger and more modern building slips and larger and more effective shops, in order to permit the construction of the capital ships provided in the Navy's three-year building programme, and to cut down the time of construction and save on the all-important item of labor. Development along these lines has not been required for the merchant programme, and has, therefore, taken place only at the navy yards and at the plants of the older shipyards, which have in the past been the builders of the Navy's armored vessels.

From a purely engineering point of view, that form of development is likely to be the more interesting which provides for the building of the largest vessels, the handling of the greatest weights, and, therefore, the construction of the largest building ways and shops. Where the expansion of the shipbuilding facilities has been obtained by the creation of new yards of a few ways each, it would not be expected that any unusual plant developments would result. In the case of the great fabricating yards, there are, of course, many new problems, due to the vast size of the undertakings; but on the whole it is more a question of multiplying the slips and other facilities such as exist in yards with few slips than the creation of new designs of shops or new arrangements of slips and plants. The great increase in the number of slips in the newer fabricating yards, which is required by the number of vessels to be built and the short periods of construction contemplated, involves a multiplication of the number of men formerly employed in shipyards, of the weight of material handled, of the provisions necessary for the receipt and unloading of cars, and of many of the other problems involved in the operation of the yards.

* Paper read at twenty-sixth general meeting of the Society of Naval Architects and Marine Engineers, Philadelphia, Pa., November 15, 1918.

So far the expansion of the shipyards of the country has been almost entirely in the direction of shipbuilding. After the vessels now being turned out in large numbers by the Emergency Fleet Corporation have been put in service there will be a gradual shifting of the burden from the building to the repairing yards. It is perhaps well to look somewhat into the basis by which the capacities of both building and repairing yards can be considered.

Building and Repairing

As regards building, the natural unit is the building slip. A yard with so many slips should be able to turn out a definite number of vessels per year, depending on the length of time during which a vessel must remain on the ways. All other calculations are based on the number of slips provided and the estimated length of time that the vessels are to remain on the slips; that is, the extent of the shops, of the storehouses, of the fitting-out berths required, and the number of men that it is expected to employ; therefore, provisions for housing and transportation are all a function of the number of slips and the length of time on the slips.

In passing from consideration of the building problem to the repair problem, this general method of viewing the question is lost, and some other basis of estimate must be adopted. The one which seems most nearly to meet the problem is the amount of berthing space; that is, the number of vessels that can be drawn into a yard at one time on which repairs can be carried out. Assuming a definite amount of berthing space, the maximum number of ships that can be under repair at a time is determined, and the extent of shops and the number of men for which provision must be made follows more or less automatically.

Building Slips

With a basis for arriving at the facilities required per building slip, and similarly per hundred feet or per thousand feet of berthing space, means are available for arriving at a reasonable judgment as to the total requirements for yards engaged on both new construction and repair work. Some of the more important elements of the shipyards, especially those involving greatly increased size or capacity, as compared to the earlier installations, will be briefly touched on.

The building slip itself, apart from weight handling facilities, has undergone comparatively little change. Concrete has been extensively used, but the majority of the new slips are of wood pile construction, and there is nothing unusual in their size except in the comparatively limited number of slips being provided for capital ship construction. These, in general, make provision for ships of a maximum length of 1,000 feet and beam of 110 feet, being the limiting size of vessels that can pass through the

Panama Canal locks. So far as the beam is concerned, this does not represent a very radical increase over the largest battleships previously built, but makes provision for a very great increase in the length as compared to vessels which have been so far constructed in this country, and involves the consideration of launching weights and facilities suitable for vessels of these great lengths. In the Navy Department designs the capital slips have all been provided with an average inclination of slips of one-half inch per foot, provision being made for launching on a camber, the actual declivity of the building slips being seven-sixteenths inch per foot for the upper half and nine-sixteenths inch per foot for the lower half of the slip.

The design of these slips contemplates the use of concrete throughout, though in a number of cases, due to lack of time or money, it has been necessary to substitute wood pile construction. With concrete slips of this great length, and the height that necessarily must be reached at the upper end of the slip, provision can be made for utilizing a very considerable area underneath the slip for stowage purposes and for carrying on such classes of work as can most advantageously be done in the immediate vicinity of the vessel under construction.

Dry Dock with Reduced Draft

An interesting type of building slip, which perhaps is the first of its kind, at least on such a large scale, has been provided at one of our navy yards, where a shallow drydock has been constructed with a depth over the blocks at mean high water of 20 feet. The dock has essentially the same dimensions as the other capital slips, providing for a vessel slightly under 1,000 feet long and of a beam of 110 feet, and in the details of construction resembling other large drydocks, except that the draft is very much reduced. The caisson will be of the usual type; provision will be made for pumping out the dock, but at a very much slower rate than would be needed if it were to be normally used as a dry dock. With this arrangement the weight handling facilities could be of any type that might be selected for the normal type of slip. In this particular case the cranes are to be of the traveling, rotating, hammerhead type, with a capacity of 15 tons at 85 feet radius, electrically driven. The advantages which we look forward to in this construction are, first, of course, the elimination of the risk and expense of launching, and, second, the facilitating of the erection, due to building on an even keel, and the elimination of the difficulties incident to delivering men and materials at the height of a vessel when built on an inclination. In addition to being on an even keel, the vessel will be very much lower, approximately 50 feet, and the height of the weight-handling cranes can be correspondingly reduced. If the conditions at the yard at the time make it desirable, the vessel can be carried to any degree of completion prior to launching, with the only limitation that the draft cannot exceed the depth of water over the blocks. The other side of the picture is the increased cost, which in this particular case, owing to the subsoil conditions, not requiring piling, is not expected to be materially greater than in the case of the usual form of slip. For naval purposes, a building slip of this type has a further value, in that considerable periods of time may elapse during which building work is not carried out, and the slip will then be available for use as a drydock or a wet slip for small vessels.

There is perhaps more room for individual preference in the selection of the type of cranes to be used for handling material at the building slips than in any other feature of shipbuilding yards. This freedom of choice has been fully exercised in the extension of the older yards and the construction of the newer ones. With the exception of a limited number of special installations, such as the cableways used in some of the western yards, the available types fall into three general classes:

Crane Service for Building Slips

1. Traveling, traversing cranes. Those which have both a longitudinal travel and a cross travel.
2. Traveling, rotating cranes. Those which have a longitudinal travel and a rotating motion.
3. Fixed, rotating cranes. Those which have no longitudinal travel, and deliver their material at the desired point by rotating, and either by trolleying or luffing.

In the first class is included the cantilever type, which was in favor in the early days of large shipbuilding, but which has now generally been abandoned, at least as far as new installations are concerned; and the bridge type, which probably gives the most effective service, though generally at the highest cost. Cantilever cranes are not a desirable type on account of the great inertia of the moving part, and on account of the limited number of hooks that can be made available, the combination tending to limit the speed of erection. Bridge cranes permit the handling of the heaviest weights and provide an installation that most nearly approximates shop conditions, so far as concerns ability to deliver material at all points. The principal argument against this type is its initial cost. It has been generally adopted for the larger and more expensive slips, and some one of the rotating types has found most favor for the slips intended for smaller vessels, or where it is not feasible to finance the higher original cost.

Special Types of Cranes

The traveling, rotating types include the hammerhead and luffing types of cranes operating on wide-gage tracks on the ground, and also electric and steam locomotive cranes operating on runways of the general type used with cantilever cranes. The cost of these types are apt to be less than bridge cranes and also less than the fixed, rotating cranes, if a limited service only is to be provided. With an equivalent service as compared with the fixed, rotating cranes, the cost should not be radically different. Some very rapid construction in the last few years has been done, utilizing electric locomotive cranes on elevated runways, and where the weights to be handled are not high or the length of the ships under construction great, this gives an effective service. The cranes that travel on the ground are more expensive than is at first apparent, on account of the cost of the track installation. Their longitudinal travel is relatively slow, owing to the inertia of the moving parts. In general, this class of crane appears to the best advantage in building vessels of moderate size, where the individual weights to be handled are not large.

The fixed and rotating cranes involve a great variety of types, which include the hammerhead type, the luffing boom type, both rotating on relatively high towers, the staid type supported on the ground, and derricks placed on towers such as are in general use in building construction. In general, the most suitable field for this class of crane is the slip for smaller ships, involving the handling of small weights, as the handling of relatively heavy weights means the providing of a large capacity for most or all of the cranes. The chief objection to them lies in their relatively small capacity and short reach, necessity for large numbers of operators, and the difficulty in delivering and storing material within reach of the crane to be used in placing it on board the vessel.

There have been some recent installations in the navy yards of the revolving, hammerhead type of cranes, which for small vessels have proved to be very satisfactory. These have a capacity of 5 tons at 95-foot radius and 10 tons at 50-foot radius, the height of hook being about 95 feet above the ground. The new capital slips being built in the navy yards are all of the bridge crane type with characteristics adopted after many tentative designs which considered capacities from 10 tons to 150 tons. The arrangement as finally adopted provides for two 40-ton cranes, each spanning the entire structure, and permitting a lift of 80 tons, with a double row of cranes above the main cranes, all of them plumbing the center line and having capacities of 10 tons each.

In these slips provision has been made for the construction of a maximum vessel of 110-foot beam, or for two merchant vessels abreast or three destroyers abreast. The clear width between the columns of the crane runways is 130 feet, and the columns slope outward so that the hooks of the cranes will plumb the centers of cars on the standard gage tracks running the length of the slip under the towers on each side. This requires a crane span of 151 feet 9½ inches. The height of the hooks of the main cranes above the yard level approximates 125 feet. The center to center width of these slips is 164 feet, and, as they provide for the construction of ships with 110-foot beam, the ratio of slip to vessel is 1.49. This is a dimension that has a direct bearing on the selection of the type of crane to be used. The ratio of the distance between centers of slip to the beam of vessel becomes in large yards a feature of considerable importance as regulating the total amount of waterfront required for a given number of ways, and to a certain extent the area of land to be included in the plant. As many factors of cost of plant bear a direct relation to the area, any unnecessary extension involves an undesirable increase in cost.

Structural Shop

The activities of the yard most directly connected with the building of ships are housed in the structural or shipfitters' shop. There has been, in the development of the larger private yards and of the principal navy yards, a tendency to adopt common characteristics, with the result that some of the largest private and government plants have adopted almost identical characteristics, though arrived at independently. In several instances the navy yards are erecting a structural group which includes not only the shipfitters' shop, but also the forge shop and boiler shop, and may later include the sheet metal and pipe shops. The shipfitters' shop in each of these cases consists of two bays, one for plate work and one for angle work, each 100 feet wide and 700 feet long, a mold loft being provided over the angle bay of the full size of that shop. The under side of the floor of the mold loft and of the roof trusses of the plate shop is at a height of 45 feet above the shop level, and the height of mold loft from floor to roof trusses is 9 feet.

The plate and angle shops are provided with three tiers of cranes, the upper tier spanning the full width of each bay, having 15 tons capacity and providing for a total lift of 30 tons; the second tier consisting of traveling jib cranes of 3 and 5 tons capacity at reaches of 30 and 20 feet with a hook height of 25 feet. The lower tier consists of special cranes intended to carry yoke riveters and smaller portable tools. For these last cranes, electric motors for travel are provided with a swinging boom and a chain hoist to facilitate the handling of such tools. The lower tier of cranes will extend for about a third of the length of the shop at the outgoing end, as they are intended primarily for work in connection with assembling and riveting.

Structural material is to be stowed on the principle followed by many of the bridge builders, a series of bridge cranes operating on runways extending across the incoming end of the shop. This stowage space will provide an area of approximately 160,000 square feet, consisting of four bays served by bridge cranes with 80-foot spans, and the area will eventually be roofed over. It is proposed to deliver material into the stowage space by standard gage tracks, and to deliver into the bays of the shop by narrow gage tracks. It is not expected that 160,000 square feet will give the full stowage area required for building and repair work for the largest yards, and further provision will be made for a reserve stowage in a less central location.

Continuous flow of work is to be obtained by the raw material entering at the end of the shop adjacent to the stowage yard, going first to the laying-off space, then to the fabricating area and thence to the assembly space and out at the opposite end of the shop, delivery from the shop to the building slips being by means of standard gage tracks. With this arrangement, a piece of material may be delivered from any point in the shop to any ship under construction with a maximum of three moves—the first from its position in the shop to a car by means of a bridge crane, the second by the transfer of the car under the slip, and, third, from the car to the location desired on the ship by a bridge crane. There is no combination of shop bays and building slips, where there is more than one of each, that can accomplish this transfer with less than three moves.

The size of plates used in ship construction has grown steadily, and an effort has been made in laying out these shops to adopt as the maximum size that we are likely to come to—a plate 36 feet long by 8 feet wide—and to provide machine tools and arrangements so that any increase in size up to this point may be taken care of without the discarding of the present outfit or its rearrangement. In comparatively recent years we have gone successively through the stages of equipping for 24-foot, 28-foot, 30-foot and 36-foot plates. The cost of equipment, especially rolls, increases rapidly at the very long lengths, and machine tool manufacturers are not generally equipped to provide machines of greater capacities, so it is likely that an increase beyond this size will not come for some time.

(To be continued.)

All Merchant Vessels Again Manned by Merchant Sailors

In consequence of the elimination of the submarine danger, with the attendant discontinuance of the convoy and other naval regulations which governed the movements of cargo vessels during the war emergency, it has been decided to man all outcoming vessels, except for the present those steamers engaged in the transport of troops, with merchant sailors. In making this decision the Shipping Board has been guided by the necessity of restoring the usual commercial conditions governing the operation of merchant vessels as rapidly as possible, in order to enable the ordinary competitive conditions to be met.

During the war it was for military reasons considered proper that many of the vessels should be under naval regulations, as they were instruments of our military operations in Europe. Many merchant vessels manned by the usual merchant crews also operated through the submarine- and mine-infested waters.

Marine Diesel Oil Engine Problems—I*

Positive Reversing Mechanism on Two- and Four-Cycle Engines—Special Starting Methods—Auxiliary Compressor Unit for Maneuvering

BY JOHN W. ANDERSON

THE method of reversing is one of the first questions to be considered in the design of a marine engine. The original European companies adopted certain forms which they patented, and hence any new firm had to obtain a license for the use of one of the accepted types or devise an entirely new scheme. In most cases a license was obtained for the design of the engine as a whole, which, of course, included such details as the reversing gears. For instance, in this country The New London Ship and Engine Company obtained a license from the M. A. N. Company of Germany, and all of the engines built by the American company follow the German designs in certain particulars. This is particularly true of the method of reversing used on the two-cycle engines.

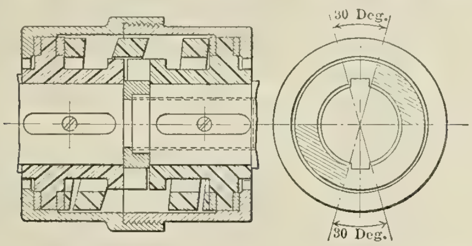

Fig. 1.—Slip Coupling for Automatic Shift or Camshaft

The method of reversing used on the two-cycle engines is based on the fact that in these engines the spray and scavenger valves can be set right for running in the reverse direction by shifting the cams through a common angle. One camshaft running along the tops of the working cylinders operates all the valves; there is one cam for each spray and scavenger valve, and the camshaft is shifted for reversing through an angle of 30 degrees. The camshaft is shifted automatically by a slip coupling, Fig. 1, having a 30-degree angle between the jaws, so that when the engine starts in the reverse direction the crankshaft revolves 30 degrees before the camshaft starts; that is, when the timing becomes right for the new direction of rotation. The air starting valves are operated by two separate cams, one for ahead and one for astern, and the direction of rotation of the engine is determined by bringing into action the proper cam, which in turn times the starting valve.

Method of Reversing Two-Cycle Engines

This automatic reversing mechanism fails to work satisfactorily when the engine is operated at low speed, because then the engine does not turn exactly uniformly; and since the slip clutch is of the friction type with jaws to limit the extreme travel to 30 degrees and the camshaft and its parts have inertia of their own, this slip clutch fails to hold the camshaft in exact relation to the crankshaft. This upsets the timing of the valves, which in the case of the spray valve is important.

In the 1,000-horsepower engine installed in the single-screw submarine tender *Fulton*, the shifting of the camshaft was made definite and positive by substituting, in place of the slip clutch, a sliding sleeve operated by a pneumatic cylinder under the control of the handling gear shown in Fig. 2. The vertical shaft, which drives the camshaft from the crankshaft, is cut and the sliding sleeve connects the two parts; it slides on one of them on straight keys parallel to the longitudinal axis of the shaft, and on the other on spiral grooves, so that when the sleeve is moved along the axis of the vertical shaft the camshaft is twisted relatively to the crankshaft through the same angle of shifting used in the original design, namely, 30 degrees.

To make the action still more positive, there is an automatic locking device on the pneumatic cylinder. It consists of a bar with two holes, connected to the lever operating the sleeve; corresponding to these holes there are two locking pins, one for each end of the pneumatic cylinder. The parts are so arranged that when the sleeve is in either extreme position, one of the locking pins fits into the proper hole in the locking bar and the parts are held securely in place.

When it is desired to reverse the engine, air is admitted by the handling gear to a piston on the locking pin holding the bar. This air pressure pulls the locking pin out, and when the pin is clear of the bar a port is uncovered leading to the pneumatic cylinder. The air pressure, acting on the piston in the cylinder, moves it to the other extreme position, setting the camshaft right for running in the opposite direction, and just as it reaches the extreme position it uncovers a port in the cylinder, admitting the air to the air starting valves on the working cylinders. Of course it is understood that when this gear reaches its new extreme position, the locking pin at that end of the cylinder registers with the hole in the bar and again locks the mechanism. The action is very simple and thoroughly foolproof and positive. This engine has been in service for some time now, and the reversing gear has amply lived up to expectations.

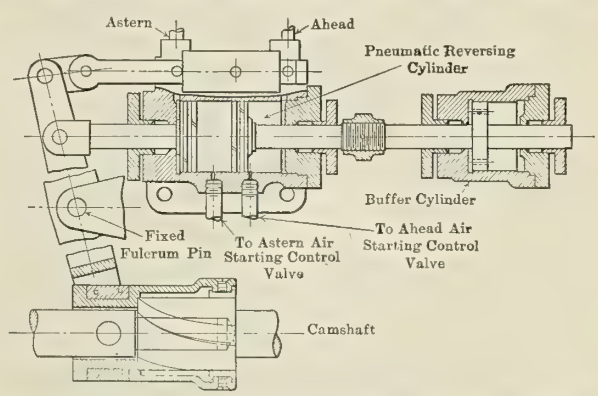

Fig. 2.—Details of Reversing Mechanism of Submarine Tender *Fulton*

Reversing Mechanism on Four-Cycle Engines

A similar method of reversing has been developed by the American company for use on four-cycle engines (Fig. 3), but unfortunately in this case it is necessary to have a separate camshaft for each kind of valve because of the different angles through which it is necessary to shift the cams in order to bring the timing right for the new direc-

* Paper presented before The American Society of Mechanical Engineers, New York, December, 1918.

tion of running. The engines are fitted with three camshafts, one for the spray valves, one for the inlet valves, and one for the exhaust valves. The air starting valves are operated by a single cam, which is shifted by a separate mechanism to bring its timing right. The operation is pneumatic and the valves are controlled by plungers arranged radially around the single cam, in accordance with the proper sequence of cranks. All of the camshafts are shifted by means of a single pneumatic cylinder operating sliding sleeves similar to the one just described, except for the addition of a set of jaws on the camshaft, which register with jaws in the sliding sleeve in its extreme positions and take the driving effort. The work of the spiral grooves is thus confined exclusively to shifting the camshaft. As in the two-cycle engines, only a single cam is provided for each valve. This method of reversing has been applied to several engines and acts as satisfactorily in the case of the four-cycle engines as for the two-cycle.

The method of starting a Diesel engine which is almost universally used is by means of compressed air, and in

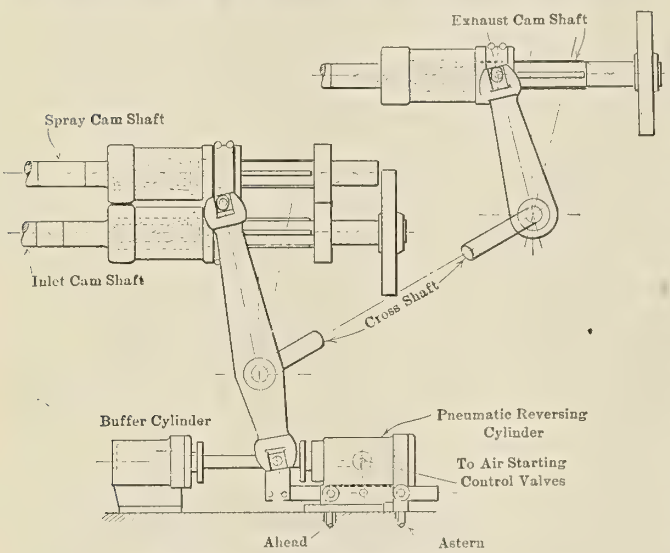

Fig. 3.—Four-Cycle Engine Reversing Mechanism

most cases the air enters the working cylinders. The objection often raised against this practice is that rapid temperature changes are produced in the cylinders by the chilling effect of the expanding starting air alternating with the heat due to compression and then, after a few strokes, the heat due to combustion. However, this method gives satisfactory service and no ill effects are known to result in the cylinder from its use.

Starting

In starting, the air is ordinarily turned on for only a few seconds, and in a few seconds more the engine can be brought right up to full power if desired. In fact, with a perfectly cold engine, the operation will be a great deal smoother under a moderate load immediately after starting than it will be at a very light load. This applies particularly at low speeds. For stationary engines which operate at full speed only, this condition is not encountered because the engine is brought up to full speed immediately after starting and the flywheel has inertia enough to keep the engine running smoothly, even though ignitions are somewhat irregular.

In a marine engine the case is entirely different. Here it may be desired to start an engine slow ahead or astern, which, with a small, light, high-speed engine, is difficult, unless a clutch between the engine and propeller permits the engine to be started up independently, warmed up, and then the clutch thrown in. The trouble in starting up when the engine is connected directly to the propeller is that in order to get the first ignition the fuel is turned well on, and when the first ignition does come there is enough energy in the combustion to overcome the inertia of the parts and drive the engine up to a much higher speed than is desired. With large, heavy engines this tendency is not nearly so marked, and it is possible to get a slow, smooth start. Here the energy of the first combustion is not nearly as great in proportion to the mass of the moving parts.

A Smooth Start on a Cold Engine

There are several ways to assist in getting a smooth start on a cold engine, and it is important to follow one of them in the case of large engines. One method is to heat the jacket water by turning steam in from an auxiliary boiler. In this way the cylinder walls can be warmed up to something approaching the working temperatures, and a smooth start is easily made. Another method, particularly useful in installations where very heavy fuels are used, is to start with a lighter fuel. By a lighter fuel is meant one that ignites readily and is more easily broken up so as to expose more surface to the heated air in the cylinder in the compression space, and thus give a quicker ignition. The solution of the problem of getting a good, smooth start consists essentially in having the temperature in the cylinders approximately the same as under working conditions and then injecting the fuel positively and regularly. Any method which does this will solve the problem.

Starting Valves on Half of the Working Cylinders

Generally speaking, stationary engines and marine engines with clutches between the engine and propeller are fitted with starting valves on only half of the working cylinders. This means that while the engine is being turned over by starting air on part of the cylinders, the others are being warmed up by the compression, and even under very adverse conditions they soon reach such a temperature that ignition is obtained. In the case of reversing engines the handling gear is sometimes modified to cause the starting air to be turned on and off the cylinders in groups. For instance, it may be necessary at times when reversing to turn the starting air on to all of the cylinders to get the engine moving in the reverse direction, and once this is accomplished the air can be cut off from the various groups in succession and the fuel turned on. The operation is performed automatically, so that it requires no attention on the part of the engineer, and the starting becomes very simple and positive. This system is also economical in the use of starting air.

Maneuvering

The question of maneuvering is principally one of obtaining sufficient starting-air capacity, either by carrying a large number of flasks or—a much better way in the case of a large ship—by having an auxiliary compressor unit of good capacity. While the ship is maneuvering, the compressor unit is kept running all the time and pumps into the starting flasks. With such a provision an engine can be reversed repeatedly with only a very small starting-flask capacity.

In the case of small powers, it is much more convenient to use a clutch between the engine and propeller and employ a non-reversing engine which is kept running all the time. The question of size of power with which this method can be used to advantage depends on the size and weight of clutch that can be obtained. The reverse

clutches built on the Atlantic Coast in the United States are, generally speaking, rather small and light, and this is undoubtedly due to the fact that the demand is for engines of the pleasure boat type, which are of relatively high speed and of low or moderate power.

The conditions are different on the Pacific Coast, where the demand is for heavy-work boat engines with large, heavy clutches. These clutches are built up to almost any size that would be used in anything short of a sea-going ship. A clutch fitted to a four-cylinder, four-cycle engine developing 240 horsepower at 240 revolutions per minute has been in use on a tow boat for about three years now, under very severe conditions, and the tug has done some extremely good work. Perhaps the best idea can be obtained as to the duty on these clutches when it is stated that the tug is used for handling large log rafts, a work which requires continual maneuvering for hours at a time.

When a clutch is used, it is only necessary to carry starting-flask capacity enough to start the engine originally. Once it is started there is no further drain on the starting flask, no matter how much maneuvering is done, and for the smaller commercial installations, where initial cost and simplicity are prime factors, this is a very important simplification.

Operation at Slow Speed

The charge is often made against the Diesel engine that it is impossible to slow it down materially. This is true to a certain extent of the ordinary type of construction, but with the proper modifications any Diesel engine can be made to slow down and operate as readily at the lower speeds as at the higher. The solution of the problem consists in having a regular enough turning moment to keep the engine running fairly smoothly, and in obtaining definite and regular ignitions in the cylinders. The case is much simpler for a large, heavy engine which has a big mass in the moving parts, and where there are a larger number of cylinders, say at least six for a two-cycle engine and eight for a four-cycle engine, than it is for a small, light engine.

In the propulsion of a ship the power drops off very rapidly as the revolutions are reduced, and therefore at very low speeds the power is so small that when divided up among all of the cylinders in the engine there is not enough fuel injected into each cylinder to give regular ignitions. This can be remedied in a large measure by cutting out half of the cylinders. The load per cylinder will then be more than doubled and the engine will run with very light loads at low revolutions.

Control of Lift and Timing of Spray Valve

Another method consists in the control of the spray-valve lift and timing by the operator. The control mechanism is so arranged that the timing and lift are changed at the same time. In some cases the valve is made to open at the same time under all settings and to close earlier, while in others it delays the time of opening by the same amount the time of closing is shortened. Both systems appear to work satisfactorily. When it is desired to slow the engine down the fuel supply is reduced, the spray-valve lift reduced and the timing changed and the spray-air pressure reduced somewhat. The combined effect of all these is to give regular ignitions in the cylinders, hence a smooth turning moment and good control over the engine. This method is much preferable to cutting out some of the cylinders at reduced power, since it provides more impulses smaller in size and at closer intervals, which are all very vital points when running at very low speeds.

The importance of being able to reduce the spray-valve lift and change the timing when it is desired to run at low speeds over considerable periods of time will be seen at once from the following consideration: The capacity of the air compressor is determined from the requirements for full-speed running (which is the usual condition), and the amount of spray air delivered to the engine depends upon the capacity of the compressor. The amount of spray air used by the engine depends upon the product of the area through the spray valves by the time of opening. If the lift is not changed the area through the valve is constant at all speeds. If the timing is not changed the total time of opening per unit of time is the same for all speeds.

Demonstration by Numerical Example

This last statement may sound strange at first, but is best proven by a numerical example. Suppose a spray valve is open 1/10 of a revolution on a two-cycle engine and the engine makes 5 revolutions per second, then the valve is open 1/50 of a second each time, and since it opens 5 times a second it will be open 1/10 of a second per second. Now let the engine slow down to 2 revolutions per second, then the spray valve will be open $2 \times 1/20$ second, or 1/10 second per second, the same as before. That is, while the consumption of spray air is substantially the same at all speeds, yet the quantity supplied by the compressor is approximately proportional to the speed. Consequently the lowest speed at which the engine will run depends very materially upon the ability of the compressor to keep the spray pressure up. Of course a lower spray pressure is required for low than for high speeds, and in addition the compressor has some reserve capacity at full speed which is available to help out at the lower speeds, but these are effective only to a certain degree. Moreover, at low speeds, when only small amounts of fuel are injected into the cylinders, the admission of large quantities of spray air seriously interferes with ignition.

Gear for Controlling Timing and Lift

The advisability of fitting some sort of gear for controlling the timing and lift of the spray valve depends upon the type of engine and the place where it is going to be installed. Without such gear, an engine can be slowed down to about half speed without difficulty, hence for installations of small power in ships having a maximum speed of 10 knots or thereabouts it is unnecessary, because half speed means little more than steerageway. On the other hand, in the case of ships having a higher maximum speed, such as 15 or 20 knots, it is very desirable to be able to slow the engines down to quarter speed or less and then the installation of such gear becomes almost a necessity. Under some circumstances, of course, it might be considered better to sacrifice maneuvering ability for the sake of simplification, but on engines of the size used on sea-going ships the slight added complication due to this gear seems every bit worth while.

Lubrication

The question of lubrication is one that is dependent upon the type of engine. The gravity system is used successfully on large open-frame, slow-speed engines, while on the small sizes, particularly where the crankcase is enclosed, a mechanical oiler is often used with leads to separate bearings or else a system of forced lubrication.

(*To be continued.*)

Revival of Mississippi River Traffic—I

BY M. VON PAGENHARDT*

Adequate use of the Mississippi River system for freight traffic has been made a fact by ratification of two Government appropriations aggregating nine and one-half million dollars. These appropriations, which will provide two fleets of barges and towboats to be operated as separate units on the upper and lower Mississippi River, will furnish one and one-half billion ton-mile capacity for upstream towing. The Government is now operating a temporary fleet, which furnishes two hundred and fifty ton-miles. In this paper a naval architect who has had a competent hand in the design of the equipment discusses the general aspects of this important undertaking. In the March issue, he will continue the subject by giving a detailed description of the floating equipment, which will consist of four 2,000-horsepower towboats, and twenty-four 3,000-ton all-steel, double-bottom hopper barges for the upper Mississippi fleet, and six tunnel towboats of 1,800 horsepower each, and forty 1,750-ton cargo-box barges for the lower route. Contracts for these boats have already been let and work begun upon them on the fabrication plan. In the April issue, the author will discuss the important factors involved in the most modern terminal installation, as these are exemplified in the work which has already been completed at St. Louis.—EDITOR.

WITH the passing of the war crisis, which has brought great planning minds together and developed a spirit of far-sighted co-operation among all the vast material-producing and material-carrying agencies of this country, permanent benefits are found in the wake. Most constructive and far-reaching are the plans on foot to develop and increase the possibilities of the inland waterways of the Mississippi Valley which thread the states of the central basin and work into the design of the ever-increasing network of railroads.

On July 12, 1918, the United States Railroad Administration under Wm. G. McAdoo, director general, took over the Mississippi River from St. Louis to the Gulf and appropriated eight million dollars (£1,600,000) for the construction of steel towboats and steel barges. A year ago the Emergency Fleet Corporation appropriated $3,160,000 (£632,000) for a fleet of barges and towboats to move iron ore and coal on a large scale on the upper Mississippi River as a carrier of commerce is undertaken Louis has already completed the first section of what will be a half million dollar (£100,000) river and rail terminal of the most efficient type. At last the utilization of the Mississippi River as a carrier of commerce is undertaken in an adequate, well-planned and well-supported manner.

We see before us two distinct and separate lines of development:

(a) The transportation of general freight on a trunk water line from St. Louis to seaboard in connection with the railroad systems and steamship lines.

(b) The transportation of commodity freight in bulk, such as iron ore from St. Paul to St. Louis, coal or even fuel oil from St. Louis to St. Paul, bauxite ores from the Arkansas district to the reduction plants at East St. Louis, silica sands from the La Salle district to the St. Louis foundries.

The "packet," making its individual weekly or semi-weekly trip, and the "bric-à-brac" passenger boat, even though they may now appear under the disguise of a self-propelled barge or "tunnel" boat, both belong to the times of Mark Twain. Since adequate revenue can only be derived from the basis of tonnage handled or, better, from the ton-mileage, a successful transportation scheme must be based upon quantity production of ton-mileage—either by carrying a large tonnage at slow speed or a smaller tonnage at greater speed. The possible ton-mile capacity of a towboat, however, is increased with a decrease of speed, consequently slower speeds with larger tonnage capacities are more economical than higher speeds with less tonnage.

TRANSPORTATION

The two distinct types of barge fleets planned by the Government for upper and lower Mississippi River traffic express more or less clearly this idea. The lower fleet, which was designed for the transportation of general railroad freight involving quick delivery and frequent sailings, consists of forty 1,750-ton cargo-box barges and six tunnel towboats of 1,800 horsepower each. A towing unit will consist of three barges and a towboat, or about 7,500 tons total displacement, capable of an average speed of 7 miles per hour.

The upper river fleet, on the other hand, designed for the transportation of commodity freight, consists of nineteen large steel barges of 2,500-ton capacity and four stern-wheel towboats of 1,600 to 2,000 horsepower each. Units, formed of three barges and a towboat, have about 10,000 tons displacement, capable of an average speed of 5½ miles per hour. Either towing unit has the same ton-mile production of not less than 50,000 ton-miles per hour. Assuming an efficiency of operation of 50 percent and a season of 240 days, the ton-mile production of either unit per season is 150 million ton-miles, which would provide a capacity of 100,000 tons

> The river cities and towns should immediately provide suitable wharves equipped with the most modern machinery for loading and unloading cargoes, together with adequate switch and other railroad connections. Elevators and warehouses should also be provided and ought to be begun without a minute's delay. Coincident with the work outlined, the business interests should organize and arrange to furnish cargoes to the capacities of the boats. This is the only way to get a fleet in the first instance, the only way to increase it, and the only way to keep it. The child is born. Don't let it die for want of a little attention during its infancy.
>
> JAMES A. REED, U. S. Senator, Missouri.

* Naval architect, St. Louis, Mo.

Fig. 1.—The First Barge Unit Leaving St. Louis for New Orleans

carried a distance of 750 miles each way. With a minimum value of only 1 mill per ton-mile, either towing unit would, therefore, show a yearly earning capacity of $150,000 (£30,000).

Practical considerations have influenced the selection of floating equipment to as great an extent as any underlying rules of economy. As is often the case with railroad transportation, given certain service conditions, it will probably seem preferable in some cases to use smaller barge units at greater speed with more frequent sailings than larger units with less frequent trips.

The Government service established on the Mississippi by order of the Railroad Administration is founded on the knowledge that regularity and dependability of service are the most satisfactory basis for permanent growth of trade traffic. A. W. Mackie, manager of the Mississippi River section and for five years active manager of the Missouri River merchandise barge line, carried the idea into effect by offering weekly sailings both from St. Louis and New Orleans. Twenty-nine all-steel merchandise barges and five towboats were placed at his disposal to establish the service.

"There are three things which will make the Government river service a success," Mr. Mackie has said. "First, the higher freight rate assures us of a greater income, even maintaining our differential of 20 percent. For instance, the rate on wheat, which forms the greatest bulk of our downstream freight, is raised from 1.57 mills per ton-mile last year to 2.26 mills per ton-mile this year; the rate on sugar, which forms a large part of our upstream tonnage, is raised from 2.36 mills per ton-mile last year to 5.85 mills per ton-mile this year. Present freight capacity with our temporary equipment may be only 250 million ton-miles per year, but with the prospective ton-mile revenue of, say, 2.5 mills, you can judge for yourself whether or not we will be self-sustaining. Second, the fact that we have contracted for six powerful towboats and forty barges of steel construction and modern design assures the stability of the service and justifies the shipper in rearranging his traffic to include this line. Third, the establishment of through freight rates in connection with railroads and steamship lines assures a dependable tonnage and enables us to serve a very large territory."

General Freight

The success of such a general freight line depends on the proper co-operation of many factors, in themselves indifferent or even opposed to the rivers service,—the general public, the shippers, the railroads, the steamship lines. To make a success of the new project under such conditions requires a complete knowledge, by those in control of policies of development, of operating conditions, and sufficient Government authority to secure co-operation of all factors involved. Further, there is the need of proper terminals with efficient handling machinery, without which a general freight service could not be made a success. The results to be obtained from the successful establishment of a trunk water line will, however, more than jus-

tify efforts and financial expeditures, and the forms of development will point out clearer and clearer the underlying rules, *i.e.:*

1. Towing units of maximum ton-mileage capacity should be utilized, even with a sacrifice of speed.
2. The river fleet should be designed for towing upstream instead of down, as at present.
3. A gradual gravitation toward heavy bulk freight should be fostered for export and import, in conjunction with the higher revenue domestic package freight.
4. Establishment of freight terminals should be made with Government aid, so that the conditions governing one city or terminal could not jeopardize the profits of the other cities interested.

Commodity Freight

The uilization of the Mississippi River for commodity freight is *a priori* successful, if undertaken on a sufficiently large scale. Well-planned routing and manipulation of freight to provide return tonnage are also involved in economic operation. Thus the transportation of iron ore from St. Paul to St. Louis—from the iron ore mines of Minnesota to the furnaces and the wealth of smelting coal of St. Louis, a distance of 675 miles on the Mississippi River—with a guaranteed return tonnage of coal, justifies expenditure in river equipment in line with the tonnage requirements.

The credit for laying this plan before the Government authorities must be given to E. F. Goltra, who, backed by detailed reports of the chief of engineers covering the technical execution of the transportation problem, succeeded in obtaining the Shipping Board's appropriation of $3,360,000 (£632,000) for the construction of the required fleet. Designs were made under the direction of the chief of engineers by Wm. S. Mitchell, engineer in charge of the St. Louis district and a member of the Government Experimental Towboat Board, and were drawn by J. W. Gerell, naval architect of the Mississippi River commission.

The result is a fleet of nineteen 2,500-ton barges and four stern-wheel towboats of 1,600 to 2,000 horsepower, which, based on the experience of the engineer office, embodies the necessary features of commodity freight transportation in the boldest form. With the assured "balanced" tonnage, "maximum" loads and terminal facilities at each end of the line, the barges were made 300 feet long, 48 feet wide and 10 feet deep. Thus the towing unit is reduced from the customary five- to eight-barge tow to a three-barge tow—the ideal form. The towboat is designed to push or pull the barges. Four units are planned to operate simultaneously for a period of 240 days. The greatest available draft may be reckoned as 8 feet during the high-water period. The minimum draft for the barges might be estimated as 4 feet; for the towboat even 3 feet probably would be sufficient. The four units are expected to transport 200,000 to 270,000 tons of ore downstream, and the same amount of coal up-stream per season.

Thus, by the expenditure of about four million dollars (£800,000), a commodity fleet is procured to move half a million tons of ore and coal per season a distance of 675 miles. To move this tonnage by rail between St. Louis and St. Paul, 1,200 cars and 16 locomotives, or an expenditure of about ten million dollars (£2,000,000) would be required, and this expenditure does not include expenditure in right-of-way, tracks and yards. In other words, this floating equipment will release 1,200 cars and 16 locomotives for higher class railroad commodities, while the lower class freight is carried by water.

As a transportation problem of national importance, this new programme has vital significance. Commodity freight, coal and iron ore, being a heavy burden on the railroad system, is ideal tonnage for water carriers. Again, while a railroad track is strictly limited in the amount of traffic it can handle, the carrying capacity of the Mississippi River is unlimited as to the amount of tonnage that can be towed in either direction. The waterway represents the nation's natural transportation safety factor; its tonnage capacity can be expanded at will by the addition of floating equipment. It represents the nation's peaceful preparedness for any heavy demand on traffic, inasmuch as any amount of commodity freight can be diverted to the waterways.

The inherent difficulties of general freight transportation—solicitation of freight, through tariffs, terminal expense—are not present when only commodity freight is handled, and the assured, balanced, maximum load possible on the upper Mississippi permits a reduction of the ton-mile cost, only paralleled by the greatest inland waterway —the Great Lakes.

The complete possibilities of the Mississippi River transportation system for general freight will only be realized when terminals at all points are efficiently equipped and when the managing organization, after extensive solicitation of freight, is able to utilize the full capacity of the equipment. Regulations controlling free tariffs and other strictly legislative features will, of course, further the development.

(To be continued.)

Preservative Coatings for Iron and Steel

FOR preserving iron and steel, it is the primary coat which is of the utmost importance, the succeeding coats being less so, while the final coat may consist of any good oil paint tinted as may be desired. When the three coats are to be applied, it is recommended that the second coat should consist of equal parts of the priming coat and of the finishing coat, the difference in color between it and the priming coat then being sufficient to show when every part of the surface has been covered. Red lead has been used for a number of years as the pigment for the priming coat. It belongs to the class of pigments known as inhibitors. Attention, however, is drawn to a series of tests on steel plates conducted by the American Society for Testing Materials, the results of which are quoted here:

Average Rating of Paint Tests

No.	Pigment	1910	1911	1912	1913	1914
9	Orange mineral........	9.0	8.3	6.9	4.0	3.0
10	Red lead...............	8.7	8.3	8.1	6.3	4.0
16	Natural graphite.......	9.1	6.8	6.6	6.2	4.0
17	Artificial graphite......	7.1	5.9	5.9	2.6	0.0
34	American vermilion....	9.1	10.0	10.0	9.8	7.5
36	Medium chrome Yellow	7.0	7.7	7.7	5.2	3.5
39	Zinc chromate.........	9.4	9.5	9.5	8.0	4.0
41	Chrome green..........	9.8	9.8	9.8	7.6	5.0
	Chromate	9.5	9.7	9.7	8.3	4.0

The figures represent the condition of the coated plates after exposure as compared with the original condition, which is rated at 10. It will be observed from these tests that the pigments showing the greatest inhibiting powers are the chromates, and especially the basic chromate of lead known as American vermilion. The high cost of this pigment has so far militated against its more general use, but it has better covering properties than red lead and, moreover, it has only about half the weight of the latter pigment, so that it yields a larger volume of paint. It is also much less prone to settle out in the can than is red lead.

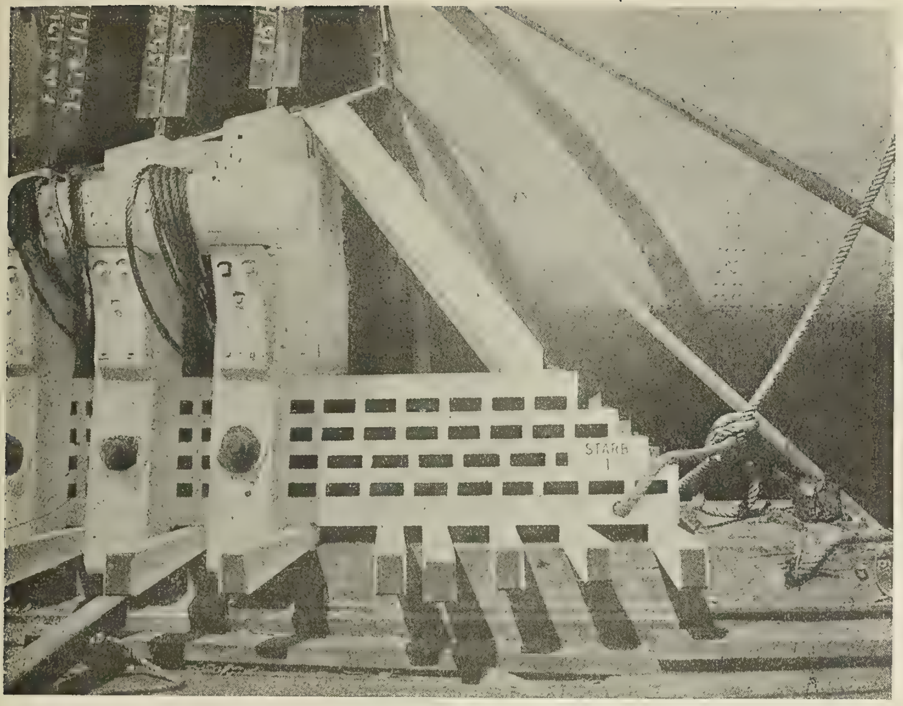

Fig. 1.—Showing Fore Poppet of Vessel with Crushing Strips in Place

NOTES ON LAUNCHING*

Use of Crushing Strips in Fore Poppets as an Effective Method of Distributing Pivot Pressure—Calculations to Determine Number, Size and Spacing

BY WILLIAM GATEWOOD†

IN connection with the launching of large and heavy vessels, for which launching calculations are made, two conditions of the operation usually receive especial attention:

The pivoting pressure, or reaction on the ways when the stern begins to lift.

The minimum moment against tipping.

The calculations as usually made are well known to naval architects, and may be found described in the transaction of this and kindred societies, and in text-books on naval architecture. The calculations assume that the level of the surface of the water is not disturbed by the entrance of the vessel, that the vessel itself remains rigid, and that the alinement of the groundways is not disturbed by the passage of the vessel. The pressures and moments obtained by the calculations must necessarily be approximations only, since the assumed conditions cannot exist in the actual launching. It is probable, however, that the results are relatively comparable, and that the calculations can be relied on with confidence in making the essential preparations for the launching.

Pivoting Pressure

Suitable provision for taking the pivoting pressure on the fore poppets was early recognized as essential, because the concentration of pressure received visual confirmation at almost every launching. It was recognized, also, that some means of distributing this pressure is necessary, as theoretically the pressure is concentrated on the extreme forward end of the sliding way. In the early days, the fore poppets were built of timbers on end; but it was soon noticed that this was not a good practice, as the compression of end grain wood is quite small compared with the compression when the grain is flat. By building up the fore poppets with the wood laid flat, an appreciable amount of compression occurs at the forward end when the vessel pivots, and the under surface of the sliding way is enabled to remain in contact with the upper surface of the groundway over an appreciable length, thus distributing the pressure between the two pairs of surfaces.

As the launching weight of vessels increased and the pivoting pressures changed from a few hundred tons to more than two thousand tons, some more definite means of distributing this pressure became necessary. The introduction in the fore poppets of a considerable depth of soft wood with grain flat seems to have served the purpose in some cases, notably in the launching of the *Lusitania* and *Mauretania.* A special rotating device or rocker formed as a segment of a trunnion has been used successfully, as described in volume 22 of the Transactions of this Society. Curving or cambering the forward end of the fore poppet cribbing to introduce a clearance for the adjustment of the bearing surfaces has been used, as noted in the discussion on the paper above referred to. Strips of soft wood especially proportioned to crush under pressure were used in the fore poppets of certain vessels launched on the Pacific Coast, as described in volume 12 of the Transactions of this Society.

The use of crushing strips in the fore poppets seems the most simple and the most effective method of distributing the pivoting pressure, and the calculations to determine the number, size and spacing of the crushing strips are not very elaborate. It is desirable, of course, to select for the crushing strips material which is uniform in quality; and white pine, flat grain yellow pine, or Port Orford cedar would seem suitable, as fairly uniform material can be obtained and the compression curves show the proper characteristics. In Fig. 2 are shown average compression curves for flat grain yellow pine and Port Orford cedar. These curves indicate that crushing begins at about 650 pounds per square inch for yellow pine and at about 750 pounds for Port Orford cedar, for which pressures the compression is less than 4 percent, and that for a compression or crushing of 30 percent the pressures are about 950 pounds per square inch and 1,200 pounds per square inch respectively. These curves are based on samples of

* Paper read before twenty-sixth general meeting of the Society of Naval Architects and Marine Engineers, Philadelphia, Pa., November 15, 1918.

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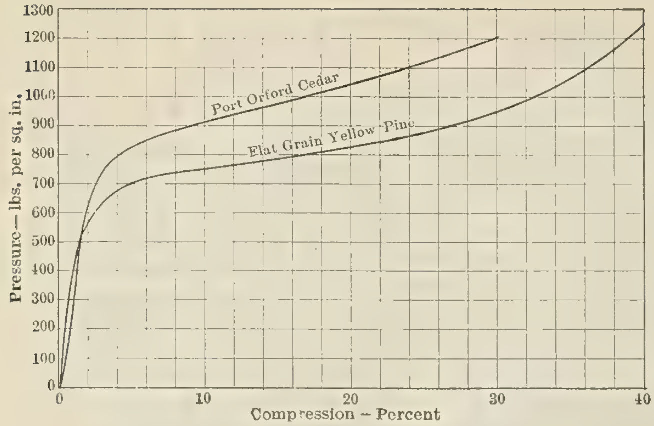


Fig. 2.—Average Compression of Crushing Strips

width equal to or greater than their height, and the variation of pressure from the mean at 30 percent compression was less than 10 percent for a large number of samples, when care was taken to eliminate resiny and unseasoned yellow pine. Slightly different values were obtained when the width was less than the height.

In order to determine the most suitable arrangement of crushing strips, it is necessary to calculate the reactions and the change in grade of the keel or sliding ways for several positions after pivoting. In Fig. 6 the reactions for a certain vessel are plotted in tons, and the angle between the sliding way and the groundway in inches per foot of length on base of distance slid and of length of overlap of ways. The curve of minimum mean pressure per foot run is obtained by dividing the reaction by the length of overlap of the ways, and it is evident that such pressures can only be obtained if the whole of the overlap of the ways is in bearing. They are based on a static launch, and are modified materially when the overlap is approaching zero by the launching velocity of the vessel as compared with the pitching period of the vessel.

The height and general construction of the fore poppet will determine what depth of crushing strips can be fitted, and the maximum crushing in inches which can be counted on will regulate the portion of the overlap of the ways which will be in contact. If we call the reaction R, and the angle between the ways expressed in inches per foot of length as a, and the maximum crushing at the forward end of the fore poppet as C, then the length of overlap in bearing will be $C \div a$, and the mean pressure per foot run on this bearing will be $\frac{R \cdot a}{C}$. The value of this mean pressure is plotted in Fig. 6 for two values of C — 3.6 inches and 4.5 inches, corresponding to 30 percent compression on 12 inches and 15 inches depth of crushing strips respectively. A convenient method of determining the distribution of the crushing strips would be to take the maximum pressure as thus determined and lay it off at the after end of the overlap in bearing corresponding to the position of the vessel where this maximum occurs (17.3 feet aft of forward end of fore poppet for $C = 4.5$ inches from data on Fig. 6), and consider it as the pressure at which crushing should just start. At the forward end of the fore poppets lay off a pressure at which crushing should just start if, when the crushing corresponds to the value of C, the pressure is the same as the pressure laid off at the after end of the length in contact. This will be about 70 percent of the mean pressure if flat grain yellow pine is used and 30 percent compression is allowed in determining the value of C. When these two spots are joined by a straight line, we have the distribution of pressure at which crushing should just start to give a uniform pressure over the length of bearing when account is taken of the crushing.

Determination of Pressure on Crushing Strips Aft

It will be found that the pressures at which crushing should start for points aft of this region may be laid off to advantage the same as the highest point just determined. and for a distance aft such that the area of the pressure diagram is equal to the pivoting pressure. The diagram will show the distribution of pressures at pivoting, as a greater pressure at any point would crush the strips, and this cannot occur before there has been a change of angle due to pivoting.

The curve of maximum pressure per foot run can be obtained by laying out the distribution of pressure for intermediate positions of the vessel up to the jump off the ways, although, as previously mentioned, the excessive pressures on the tip of the fore poppets would be experienced under static conditions only. Such a curve is indicated in Fig. 3. This curve shows a certain amount of crushing at points where later there is no crushing or less crushing, and the elasticity of the wood will probably enable the crushing strips to partially accommodate themselves to this condition, provided the percentage of crushing is not too great.

Use of Crushing Strips Satisfactory

The pressures obtained by this method would probably be reduced somewhat by the bodily lowering of the vessel due to the crushing, unless the pivoting point assumed in the calculations corresponds to the point of no crushing.

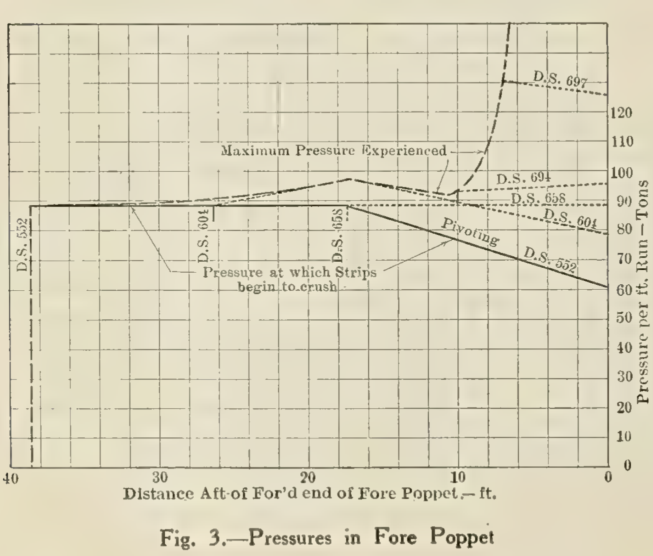


Fig. 3.—Pressures in Fore Poppet

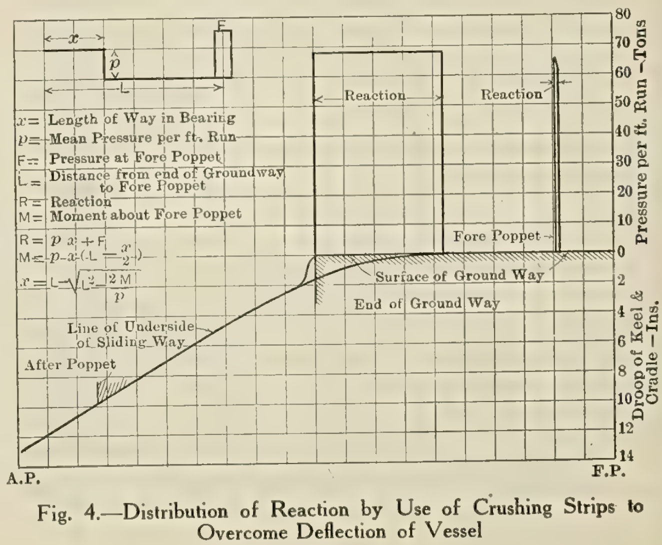


Fig. 4.—Distribution of Reaction by Use of Crushing Strips to Overcome Deflection of Vessel

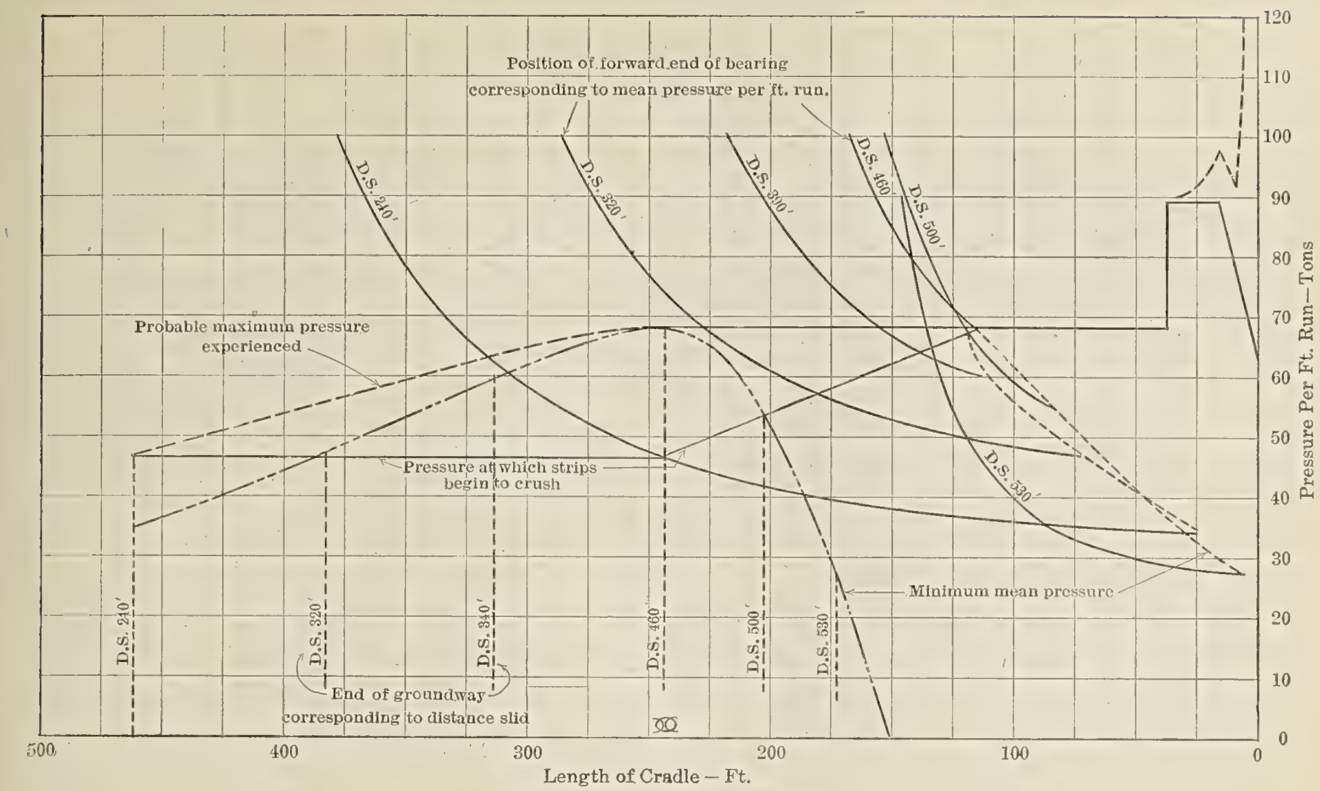


Fig. 5.—Pressures in Cradle

Fig. 1 is from a photograph of the fore poppets of a vessel with crushing strips arranged somewhat as described in the preceding example. The crushing strips seemed to serve their purpose admirably, distributing the reaction over the strap supports and distributing the pressures over the standing ways so that no trouble at all was experienced from the high pivoting pressures. The same arrangement was repeated for a sister vessel with similar success, the material of the crushing strips being white pine, which has about the same crushing curve as yellow pine. It will be noticed that the crushing strips are in four layers, which gives stability to the structure; and there is a further crushing of the division boards where the crushing strips bear, which adds to the adaptability of the design to distribute the pressures.

Further refinements may be made in the calculations, if desired, to obtain full advantage of this method of distributing the pressures. On the other hand, the crushing strips are able to stand almost any amount of overloading without disintegrating, and their use cannot fail to help distribute the pressures, even if fitted without reference to any calculations at all.

WAY END PRESSURE

The minimum moment against tipping is primarily the measure of safety against the lifting of the fore poppets from the ways and the bodily tipping of the vessel backwards as the center of gravity of the vessel passes the end of the groundways. Many of the smaller vessels have "tipped" in launching because it was considered too expensive to extend the ways a suitable distance under water. Usually, no damage has resulted from this practice, as the pressures have been comparatively small, and the ways were so supported as to "give" appreciably during the tipping.

On larger vessels, however, even with a considerable moment against tipping, damage to the floors under the flat of the bottom has resulted, caused by the concentration of pressure over the outboard end of the groundways as the part of the vessel which was damaged passed over that spot. This concentration of pressure is not indicated directly by the calculations as usually made. Special calculations are often made, however, in an endeavor to determine these pressures. In these calculations, it is assumed that the vessel and ways do not change shape and that the distribution of reaction on the ways can be represented by the ordinates of a trapezoid, having a length equal to the overlap of the ways, an area equal to the total reaction corresponding to the particular overlap selected, and with the center of gravity of the trapezoid at the center of gravity of the reaction. If the center of gravity is nearer the end of the groundways than one-third of the overlap, the trapezoid becomes a triangle whose base is three times the distance of the center of

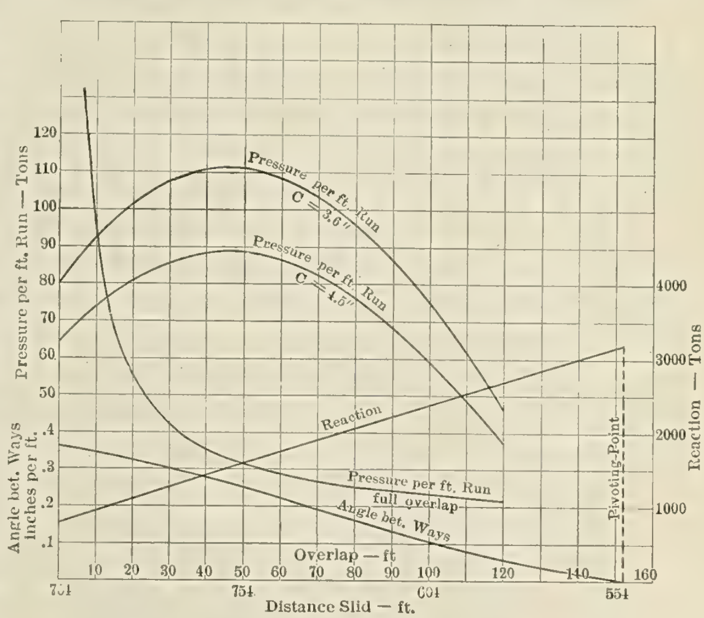


Fig. 6.—Reaction, Trim, and Pressures After Pivoting

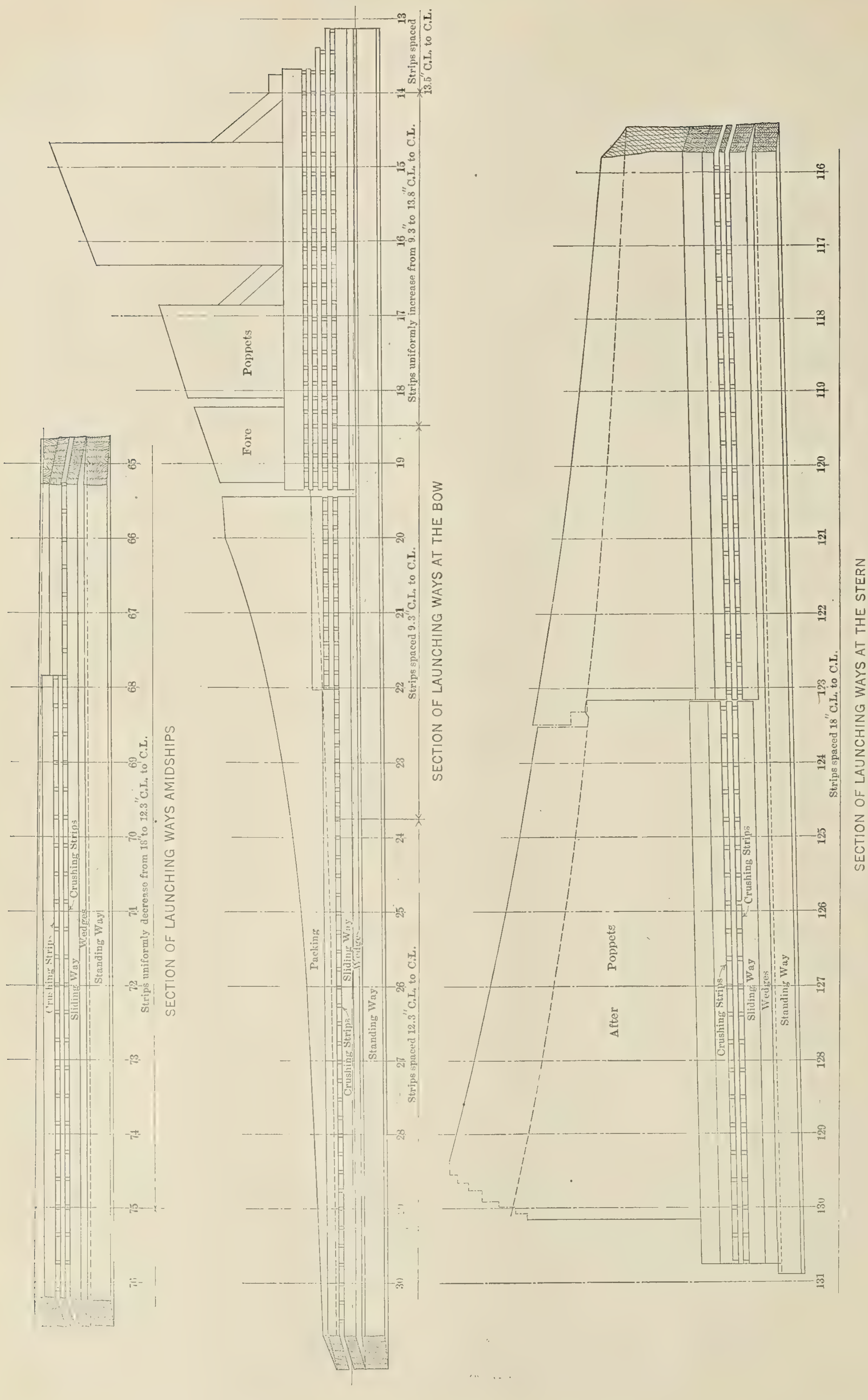


Fig. 7.—Sections of Launching Ways at the Stern, Amidships and at the Bow Showing Arrangement of Crushing Strips

gravity from the end of the groundways, and there is assumed to be no pressure at all at the forward end of the fore poppets. This method of determining the pressures under the bottom of a vessel was used in preparing for the launch of the *Lusitania*, was described in volume 12 and was illustrated in volume 22 of the Transactions of this Society.

Method of Determining Pressures Based on Theoretical Assumption

The method of determining pressures under the bottom, above described, is based on an assumption which can hardly be realized in practice. The condition which controls would seem to be that the vessel does not remain straight, but yields to the bending forces which come into play during the launching. The natural impression which one gets of a large vessel afloat is that there is no longitudinal bending. Both theory and actual measurements, however, show that vessels are flexible beams, and records of measurements are given in our Transactions. In the process of launching, the bending moments are quite pronounced and can be approximated with some degree of certainty, although considerably more data must be accumulated before they can be calculated with accuracy. Measurements taken during launching show the effect of these bending moments on the upper deck, as the stringers show considerable stretching during the passage of the vessel down the ways.

The effect of this bending of the vessel is to tend to concentrate the reaction of the ways prior to pivoting at two points—the outboard end of the groundways and the forward end of the fore poppets. The relative intensity of these two forces would vary to suit the center of reaction, and the sum of the two forces would be the total reaction on the ways, or land-borne weight. The reaction at the outboard end of the groundways would be a maximum before the position of minimum moment against tipping is reached, and is equal to

$$\frac{Wa - By}{l},$$

in which Wa is the moment of the weight about the forward end of the fore poppet; By is the moment of buoyancy about the forward end of the fore poppet; l is the overlap of the ways.

The settling of the ways, compression of the packing, and deformation of the bottom of the vessel all tend to distribute this way-end pressure, but it is manifestly unlikely, if not impossible, that the distribution of pressure can be as indicated by the trapezoidal formula. The use of crushing strips in the packing under the bottom has suggested itself as a means of distributing this bottom pressure, just as it has served as a satisfactory means of distributing the pivoting pressure. The calculations to determine the amount of the crushing strips required are not so simple as in the case of the fore poppet strips, but the following method would seem applicable.

Obtaining Distribution of Reaction on Ways

From the launching calculations, determine for several positions of the vessel the reaction on the ways and the moment of this reaction about a point chosen, say 10 feet aft of the forward end of the fore poppets. Determine, as indicated in Fig. 4, the length from the after end of the cradle over which a certain mean pressure per foot run must be applied to afford a reaction which will have the same moment as above described. Obtain similar lengths for other mean pressures, and plot the series of curves through the points so obtained (see Fig. 5). Note the points on these curves at which the reaction at the fore poppet becomes zero, as this gives the minimum mean pressure which is practicable. The highest point of the curve joining these points of minimum mean pressure gives the maximum mean pressure which need be experienced if the crushing strips are suitably arranged.

If the strips are arranged so that they will just begin to crush at the forward end of the bearing thus determined, and if they are arranged at the after end of the bearing, over the end of groundways corresponding to this position of the vessel, so that they will give this pressure per foot run after having been crushed sufficiently to permit of this length of bearing, the mean pressure per foot run over the whole length of bearing may be obtained by arranging the strips in between so that they will begin crushing at the proper pressure to give this mean pressure after crushing to suit the curvature of the vessel in this position. It is assumed in the diagram in Fig. 5 that a straight line variation will prove satisfactory.

If we assume that the wedging up has adjusted the cradle so that no bending will occur to localize the pressures until after the after end of cradle has passed the end of groundways, it will be seen that in the after poppets the pressure will be not much different from the mean pressure due to the weight of the vessel. In that part of the cradle, therefore, the crushing strips can be arranged to give only a slight margin over this mean pressure, say about 25 percent, to allow for irregularities in the strips.

The crushing strips can be arranged to give uniformly varying pressures between the after end of cradle and the outboard end of the bearing for maximum mean pressures (shown uniform in the diagram) without causing the above determined maximum mean pressure to be exceeded. Between the inboard end of this bearing and the outboard end of the fore poppet bearing, an arrangement of strips to give uniform beginning of crushing would seem satisfactory.

Obtaining Maximum Pressure Over the Way-End

In order to determine with accuracy the maximum pressures over the way-end when crushing strips are fitted as above outlined, it will be necessary to calculate the deflection of the vessel in several positions and plot the pressures corresponding to the crushing and spacing of the strips, as indicated in Fig. 5, to give the proper reaction and moment. The curve shown in Fig. 5 represents the probable maximum pressures which will be experienced if the crushing strips are sufficiently thick to actually cause the sliding way to accommodate itself to the groundway.

In Fig. 7 is shown the distribution of crushing strips which corresponds to the pressures shown in Fig. 5. Four rows of 2-inch by 3-inch strips are shown in the fore poppet, one row is shown where the height is limited, and two rows amidships and aft, where there is sufficient height to fit them.

One further condition needs to be mentioned. Although the crushing strips do not exert nearly as much pressure in returning to their original thickness as they do in being crushed, the recovery is appreciable, and there will be a considerable pressure exerted between the bottom of the vessel and the sliding way outboard of the end of the groundway. This pressure may be sufficient to break the sliding way if there is an appreciable crushing of the strips, as the sliding way has considerable rigidity. The excessive bending moment on the sliding way may be relieved by cambering the last few feet of the groundway.

Analysis of Freight Movements at Terminals

Outbound and Inbound Quay and Pier Transference—Movements in Warehouse and on Vessel—Standardized Machinery Available

BY H. McL. HARDING*

To be able to adapt and to apply standard machinery to the transferring and handling of miscellaneous freight at marine terminals, it is essential not only to know and fully understand the movements of the freight under the usual commercial traffic conditions, but also the reasons why freight is moved in this manner. Without this knowledge, it is difficult to comprehend how machinery can be correctly adapted to the proposed work, so as to attain the desired speed and economy for successful competition in foreign trade.

As a general proposition, it may be said that adequate facilities should provide for a continuous succession of rapid, mechanical movements without congestion and without manual rehandling. Mechanical apparatus should serve every square foot of area horizontally and every cubic foot of space vertically.

Terms Used in the Analysis

It is preferable to consider separately, first, the freight movements on the quay; second, the movements on the pier, and finally a combination of movements on both pier and quay. By thus separating the movements, the operating methods are more clearly set forth and defined. In the following analysis "transference" signifies freight movements from one place to another, as between vessel and shore; by "handling" is meant the assorting, distributing and tiering of freight chiefly on the shore and within the shed. "Stowing" refers to the placing of freight within the vessel. The first series of movements described pertain to the inboard freight of the quay.

Quay Inbound Transference

This comprises the following freight movements: From vessels (ships, or barges and lighters with or without masts) to the shore and to other vessels; from the vessel to the railway car or dray, stationed near and along the quay wall; from the vessel to the open quay areas or to the quay transit shed. Secondary movements provide for further transport from the transit shed to railway cars or drays, located in front or to the rear of the shed; from the transit shed to the terminal warehouse; from the warehouse to railway car or dray for inland destination.

Quay Outbound Transference

This transference consists of the movements from the terminal warehouse to the transit shed; from the transit shed to the vessel; from railway cars or drays to the warehouse; from railway cars or drays to the transit shed; from cars or drays to open quay areas; from cars or drays directly to vessels; from inbound vessel to outbound vessel, as between ships, barges and lighters.

Quay Inbound Handling

This refers to longitudinal and transverse traverse within the shed or on the open quay areas, including

* Member, advisory board, Port and Harbor Facilities Commission, United States Shipping Board.

Fig. 1.—Architect's Sketch Showing Plan of Harbor Improvements at Beaumont, Texas

freight movements in many directions for the assorting, distributing and tiering, all according to the marks or cross marks, for still further transport (after this handling) by railway car or by dray or by transshipment.

Quay Outbound Handling

There is much less handling of outbound freight than of inbound. In many instances the freight can be transferred directly from railway, car or dray to vessels without handling. Provision, however, must be made for longitudinal and transverse traverse with the assorting, distributing and tiering on the quay within or without the shed.

The four operations described above represent the principal freight movements in connection with the quay. The following analysis pertains to the additional freight movements on piers which are provided with side and end berths.

Pier Inbound Transference

These freight movements are from vessels berthed at the two sides of the pier or at the end of the pier to cars on the pier; from vessels to open pier areas; from vessels to pier transit sheds; from vessels to open quay areas; from vessels to railway cars or drays on the quay; from vessels to other vessels berthed on the opposite side or end of the pier or alongside; from vessels to terminal warehouses on the quay; from the pier shed by secondary movements to cars and drays on the pier; from the pier shed to the open quay areas; from the pier shed to cars on the quay; from the pier shed to the terminal warehouse on the quay.

Pier Inbound Handling

These are the longitudinal and transverse movements for assorting, distributing and tiering on the open areas or within the pier shed.

Pier Outbound Transference

These are the movements from the warehouse on the quay to open pier areas; from warehouse to pier transit shed; from warehouse to vessels berthed on the sides and end of the pier; from cars on the piers to the pier shed; from pier shed to vessels; from vessel to vessel, as from ship to ship, or from barge and lighter to ship alongside or across the pier.

Pier Outbound Handling

Where the freight is to be held temporarily for shipment, it may have to be assorted, distributed and tiered. This is accomplished by longitudinal and transverse movements often in the pier shed or on the open pier. The shipment, on the other hand, is often made up in the warehouse instead of in the shed. In some cases there is little outbound handling, but provision must be made to prevent congestion.

Warehouse Movements

In addition to the above, there are various freight movements *within* the warehouse. These movements include the transferring of freight between the different floors of the warehouse and the handling of it on the various floors.

Since the warehouse is intended for long storage, often for many months, the simplification of the mechanical movements involved in the handling are not nearly so important as in the transit shed, where freight must be moved within twenty-four to seventy-two hours. Movements between warehouse and vessel must, of course, be performed with great rapidity.

Freight Movements on the Vessels

In addition to all the freight movements already described, are those of the inbound freight on the vessel after the "breaking down" of the stowed cargo. These operations include the movement between decks and through and above the hatches of the ship, including the burtoning. The burtoning of the outbound freight is also to be considered, as well as the lowering within hatchways, the movements between decks and the final careful stowing.

It would seem as though the number of movements as enumerated is already extensive, although the weighing, customs-inspection, and the disposition of held over or held up freight, of damaged or dangerous shipments and of goods held for customs rebate have not been mentioned. Such movements must also receive thorough consideration.

The above analysis is intended to cover freight movements of every kind, nature and description and of such dimensions and weights as are usually limited by the ship's tackle and will pass within the doors of the standard freight cars. All of the above movements can be performed by mechanical means. In addition, provision must be made for freight of greater sizes and weights. Such freight, however, can be lifted, transferred and handled at a much slower speed.

Character of Freight

The usual miscellaneous freight generally will be the same as transported on the railways—packages, bales, boxes and barrels, long pipes, rails, lumber, girders and more or less bulk freight. It should be remembered that the machinery installed for this work is for a public terminal, which is intended to give service to manufacturers and dealers in *every* commodity and for *every* class of merchandise. For terminals devoted exclusively to the handling of one special commodity, the installation of special machinery is a requisite.

Standardized Service Machinery Desirable

It is of importance that at public terminals, or those which transfer and handle all classes of freight, there should be few types of machinery, and that these be of a universal character. Complete co-ordination of the different freight movements is essential. No movement should be considered as operating independently of the others; all are more or less connected. By their perfect articulation, speed, economy and great terminal capacity are possible. Commercial success in foreign trade depends upon the installation of adequate harbor facilities.

Equipment of Los Angeles Harbor

In making a claim before the Shipping Board for allocation of vessels to local navigation companies of Los Angeles, Cal., the port facilities for handling cargoes were enumerated in detail. These include a floating steam crane of 90-foot beam of 20 tons capacity; a locomotive crane with 36- and 49-foot beam of 15 tons capacity; a floating "A" frame with shear legs of 80 and 100 tons capacity; two electric wharf trucks, three gasoline (petrol) tugboats, ten lighters of from 400 to 1,000 tons capacity, one "A" frame barge and one fully equipped fireboat. One 3,000-ton dry dock is now available. Another 10,000-ton floating dock is now constructed.

The report also shows that 500 acres of anchorage are available—200 acres in the outer harbor with 48 feet of water, and 300 acres in the inner harbor with 30 feet of water. The total length of dockage on the waterfront is 33,460 feet.

Fig. 1.—American Development of Camouflage

Principles Underlying Ship Camouflage

Complementary Colors Produce Low Visibility—Dazzle System of Ambiguous Perspective Disguises Ship's Course—Special Color Effects

BY ALON BEMENT*

PRIOR to January, 1918, there were five systems of disguising ships recognized by the Ship Protection Committee of the United States Shipping Board; and, therefore, granted concessions in insurance rates. They were the culmination of that effort at concealment which, before the war, found its expression in the painting of the battleships gray. These systems were all of the low visibility type; and, though in some cases color and in others black and white were used, it was all for the same purpose—to produce gray at a distance.

Mixing Complementary Colors to Produce Gray

William Mackay was first in the field. He had been interested in concealing coloration before the war broke out, and with Commander Fisher had made experiments on small government vessels before there seemed any likelihood of the United State being involved. His theory was based on the fact that complementary colors, when mixed in the proper *proportions,* will produce gray. The truth of this contention can easily be demonstrated by the use of colored cards on a rapidly revolving wheel. If given areas are painted in the same proportions of color as those that produce gray on the wheel, and are carried far enough from the observer, the colors will seem to mix, and the areas, therefore, will become gray in the same manner as they do on the wheel. It was claimed that the gray thus produced was, owing to its greater atmospheric quality, much superior in its powers of invisibility to that of the ordinary gray paint.

The other systems, with the exception of Warner's, while varying somewhat in method, all embodied the same principle. Warner, who came late into the field, combined with a two-color low visibility effect some of the elements of the dazzle, which, at that time, began to appear on British ships.

Appended is a list of the systems, with some of the main characteristics of each, in the order in which they were accepted by the Ship Protection Committee:

The Mackay System—Three colors in spots

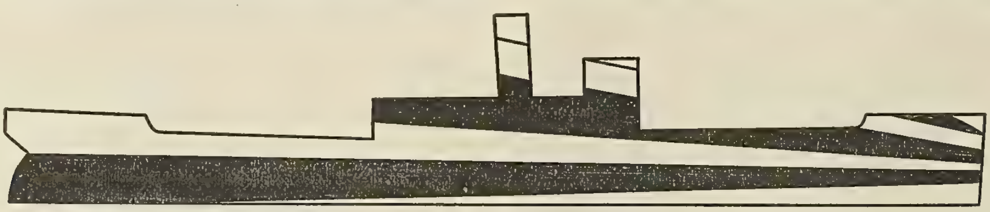


Fig. 2.—Use of Perspective Lines to Disguise Distance and Course

The Herzog System—Colored line resembling grain of wood

The Brush System—Black and white only

The Tock system—Color and wave line

The Warner System—Two colors and element of dazzle

Now these low-visibility schemes were effective to a certain degree, but they all had the same important defect. Their low visibility depended on atmospheric conditions. Given a gray day with a slight mist, they were very effective; but should the sun shine in any direction

* Camoufleur, United States Shipping Board.

except from behind the observer, they were ineffective. The catastrophes of the spring of 1917 proved that the camouflage of the low-visibility type was failing in its aim. Von Tirpitz was making good his boast to sweep clean the seas, when Commander Norman E. Wilkinson, then a junior officer in the British destroyer fleet, evolved a camouflage immeasurably superior to the old systems. His idea was not to render the ship invisible, or even hard to see, but to prevent the submarine from determining its course, speed and character.

This camouflage was based on the fact that the submarine must, under ordinary conditions, submerge for a long period between her last observation and the attack. If, then, the submarine commander could be misled in his calculation of the ship's course, he might rise to find himself too far away to deliver a blow; or, as has happened many times in the last eleven months of the war, find himself coming to the surface in the path of the ship, broadside on, and comparatively helpless.

Fig. 4.—Offsetting Rake of Stacks

Dazzle System Distorts Normal Perspective

It is said that the momentary confusion of a hawser hanging over the bow of the destroyer with the stem gave the commander his first idea of this new camouflage. Whether this is true or not, the dazzle was begun by painting several broad stripes up and down on the bow, with the intent that they should be mistaken for the stem. The British submarine men made a favorable report almost immediately, and it soon became apparent that by wrapping a band at an angle across and around the stem, or converging several of them toward a point on either side, the whole bow could be made to seem out of line. This converging of lines involved known rules of perspective. If the bow could be thrown off by perspective, why not any part of the ship? Experiment proved that by a proper use of perspective lines any part of it could be made to seem far away, in just the same way that distance is acquired in a street scene on paper by converging lines running toward a vanishing point. This is exemplified in Fig. 2. With the drawing held at arm's length, the bow of the ship will seem farther away from the observer than the stern.

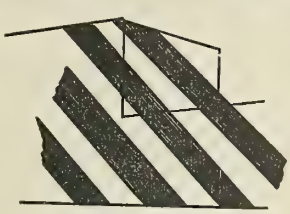


Fig. 5.—Solid Lines Conceal Bridge

Now, although this design does its work well from a broadside view, there are two reasons why it could not be applied to a ship in just this simple manner. In the first place, the enemy would understand the deception and guess very nearly the amount of deviation from the ship's course; also, while this design protects the ship from off the beam, it does not offer any protection from astern or ahead. Consequently it would have to be supplemented by other designs to cover the whole area of the ship viewed from every point, as indicated in Fig. 3. A design of this character may be said to have three attributes: It would make the vessel seem to be off her course from ahead, abeam and astern; the masses of white near the water line at the bow would reduce the visibility of the bow wave, and make it hard to calculate her speed; and, under favorable atmospheric conditions, the markings would seem to shorten her length by losing certain parts of the bow and stern against the sky.

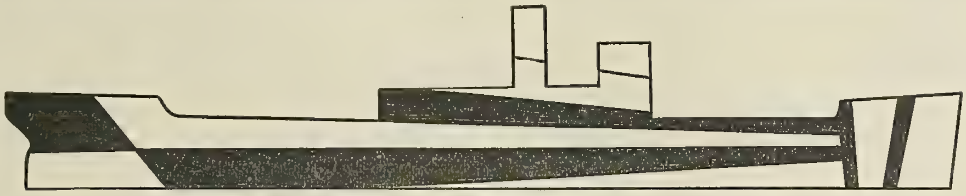


Fig. 3.—Further Use of Perspective Lines Which Disguise Course from Every Angle

View of Stacks and Masts Distorted

At this point the British under-seamen reported that, while this designing was effective as far as it went, they had no difficulty in getting the course of the ship from the masts and the bearing of the stacks over the bridge. Experiment proved that the masts could be fairly well confused by painting them different colors, one light and one dark; offsetting them a few feet was found to be a still better method. In the new ships, the design called for only one mast, which was set alongside the stack amidships. The stacks were painted with the design running against the slant to overcome their rake aft, and the tops cut with white or some light color to shorten them, as shown in Fig. 4. During the summer of 1918 several British ships appeared with the stacks built up to the vertical with a wing-plate forward at the top and another at the back below. It was an expensive method, but it served to show the faith the owners put in this particular kind of camouflage.

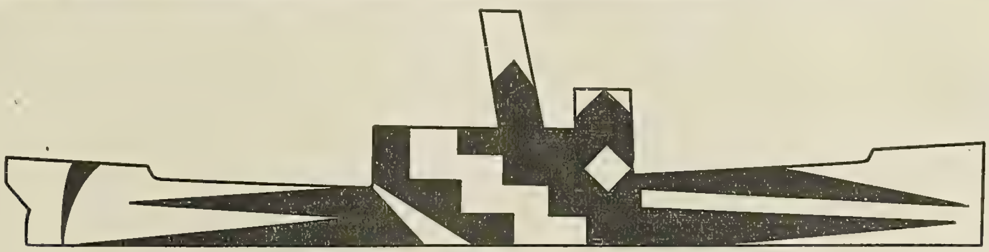


Fig. 6.—Ambiguous Dazzle Amidships Conceals Direction of Course

Disguising the Bridge and Superstructures

The last and the most difficult problem that presented itself to the camoufleurs was the breaking up of the bridge and super-structure. Characteristic as they are in shape, and towering as they do sometimes 70 or 80 feet above

the water line, with vertical corners that catch the sunlight on one side and throw deep shadows on the other, they were very difficult to disguise. It is here that the greatest failures were made, but in the effort to confuse these angles the most interesting additions were made to the knowledge of deceptive perspective. In the attempt to make the vertical plane of the front of the bridge seem to swing out and connect with the side of the hull, which is at right angles to it, many interesting discoveries were made. It was found that by extending several parallel stripes of color from the waterline diagonally aft to the rail, and then extending a similar set on a diagonal up the forward end of the house to the bridge, that the two sets would seem to connect and continue to do so while the ship swung through several degrees. Thus it became exceedingly difficult to tell whether the observer was seeing the front of the bridge or the side, as the whole area covered by the striped design would seem a single solid wall (Fig 5).

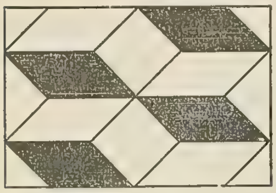


Fig. 7.—Showing Ambiguous Perspective

The same effect was obtained by extending a very wide band of color from midships up and forward, the lower edge reaching forward along the rail for 20 or 30 feet, and the bulk of the band turning the corner of the house and extending on up to the bridge. The sharp splinter of color along the rail connected with the color on the front of the superstructure. The effect was the same as in the first case, since the color arrangement made it difficult to decide just what relation the two vertical planes had to each other. Consequently, as the observer was not able to recognize the space occupied by the front of the house, he could not tell how the ship was heading.

At this point Commander Wilkinson stumbled on a practical use of the hitherto almost abandoned theory of ambiguous perspective—that kind of perspective which can be read both ways, and appears now and then as a puzzle in a picture book (Figs. 7 and 8). By a slight effort of the will the observer can see the stairs right side up or the reverse, the dark surfaces as indented or raised. This kind of perspective is valuable to the camoufleur, not only because it assists in breaking up the masses of the superstructure, but because, superimposed over the ordinary perspective, it conceals its motive. While the enemy could very easily have understood and recalculated upon the perspective of Fig. 3, the introduction of ambiguous perspective at intervals upon it would make it almost impossible for even an expert to decipher. By the application of a good ambiguous design to the midships section of a ship, with perspective lines converging away from it forward and aft, it could be made to seem to turn both ways (Fig. 6). Towards the end of the war the American designs had a very decided tendency in this direction, while the English made a sharp return to the many small and parallel stripes they had used at the very beginning. The American method was effective at a distance of from four to ten miles; the English design produced confusion at a very close range (Fig. 9).

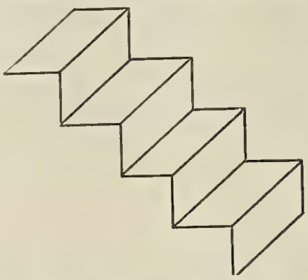


Fig. 8.—Showing Ambiguous Perspective

Purpose of the Colors Used

The choice of colors to be used was a simple one. Black and white offered the strongest contrast obtainable. A line between the two gave the sharpest edge—one that could be seen farthest. A corner casting a shadow presents a very strong edge; the only line that can offset it is one between black and white. The camoufleurs usually tried to turn or wrap the corner with a diagonal line, black above and white below. If this did not completely obliterate the corner it reduced its effect perceptibly. The strong blue was used because it presents the least contrast

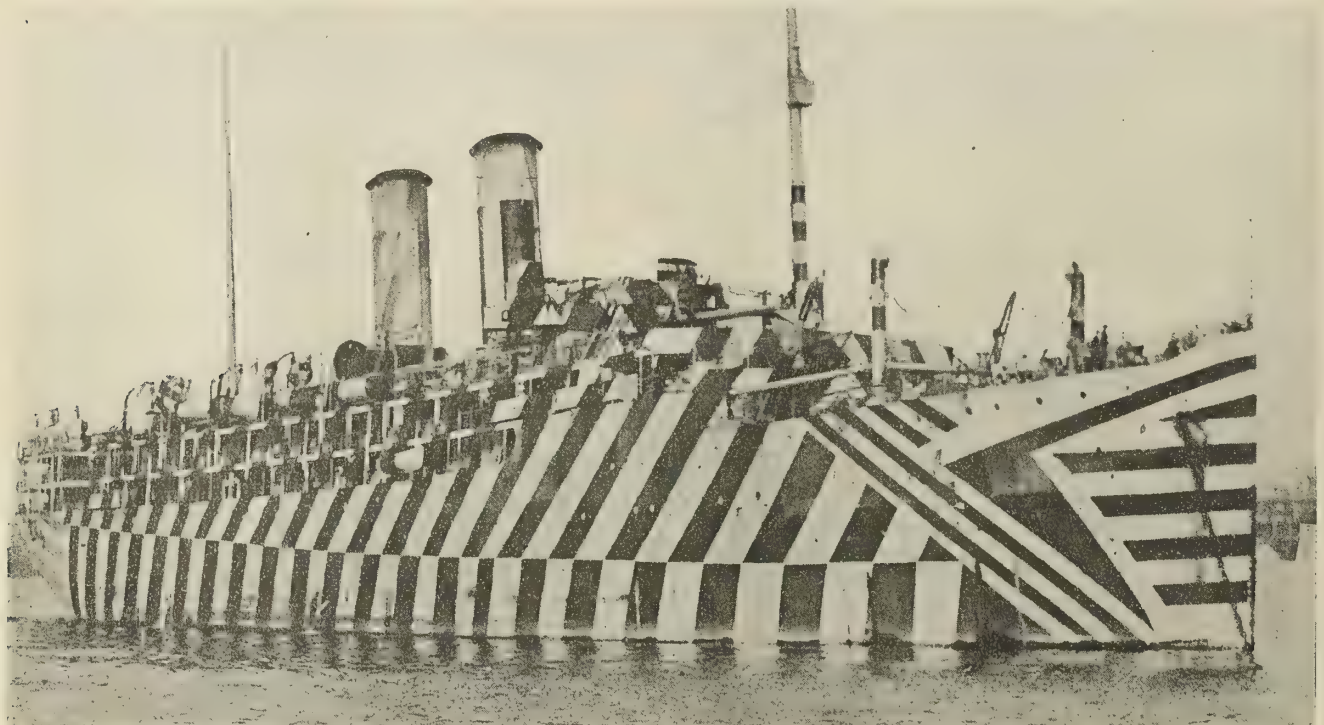


Fig. 9.—The English System of Camouflage as Applied to a Passenger Vessel

between its light and dark side. A round object painted with it will seem less round than it would if painted any other color; blue has the quality of being strong in the shadow and dull in the light. A quaint old French writer on color, Vebert, noticed this fact, and observed that it might have been occasioned by excess of modesty. The other colors were used for contrast, but in choosing them care was taken to select colors that the Germans could not screen out. Vermilion, the strongest red, can be nullified and made to seem almost white by the simple expedient of placing a color screen directly over the periscope dial.

This, the so-called English dazzle system, was adopted by the United States Navy and the Shipping Board early in 1918, and went into effect immediately. After March 1, the Shipping Board ruled that no ship could clear without it, for by that time it was recognized that the most fatal error the U-boat could make was to miscalculate a ship's course. Beyond question it was the frequency with which they committed this very error that mitigated against a successful underseas campaign.

Twin-Screw Steam Towboat—The Peace

Constructed for Inland Waterway Service—Extreme Shoal Draft Type—Propulsion by Compound Condensing Engines

In view of the interest which is being taken in tow boats for use on inland waterways and shallow rivers, the accompanying photograph shows a very successful steel steamer of this type. This vessel, which was designed by J. Murray Watts, N. A., of Philadelphia, has just been completed by the Dravo Contracting Company, of Pittsburgh, and is now in use on the Monongahela and Ohio Rivers.

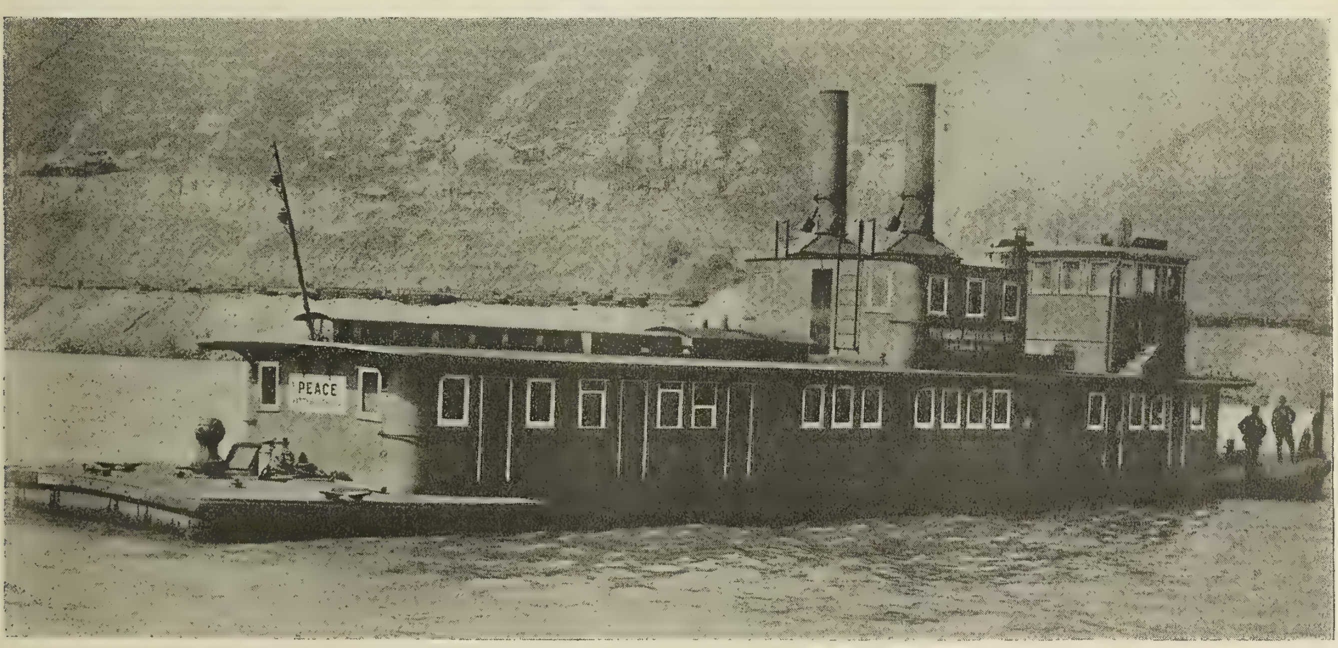
The general dimensions are: Length, 112 feet; beam, 22 feet; draft, 3 feet. The boat is propelled by compound engines of 250 horsepower each, built by the Hyde Windlass Company. Each engine drives a propeller 4 feet 4 inches in diameter. These propellers, housed in a pair of tunnels, are so arranged that the lower edge of the blades is above the bottom line of the vessel, in order that these will not be damaged should she go aground.

Steam is supplied by two large vertical boilers, 5 feet 7 inches in diameter and 15 feet long. The large size of these boilers allows a full head of steam to be carried without any difficulty; it also gives a good reserve of steam for operating the steam syphons and for pumping out the bilges of the barges which the boat may be towing.

The hull is constructed of mild steel throughout, reinforced with steel trusses to withstand the hogging strains on such a shallow hull. A steel deck house and wooden pilot house have been provided. The coal and water supply is carried in the hull. Excellent accommodations for the crew are provided in the deck house, in the after end of which are staterooms for the captain and for the eight members of the crew. A spare stateroom, bathroom and toilet room are also included. To insure ventilation in the hot summer months, a continuous skylight is built over these quarters, ventilating each stateroom. Forward there is a large galley, a pantry, a store room and a good-size dining saloon. The pilot house is raised about 3 feet above the deck house, and this space is utilized for a large gravity tank for culinary purposes.

Fitting of Five Rudders Aids in Maneuvering

Owing to the shallow draft, five rudders are fitted—three aft and two in the tunnels, forward of the propeller wheels. A Dake steam steering gear and a Dake double-steam capstan are fitted, also a hand-operated capstan on the after deck. A 5-kilowatt electric plant, operated by a De Laval turbine, furnishes current for the cabin lighting and the searchlight. In waters where the sternwheel type of steamer with simple non-condensing steam engines has been the rule, this compound condensing, propeller-driven tow boat has given a good account of herself, showing decided superiority in lightness, speed and economy.



Towboat *Peace* for River Work

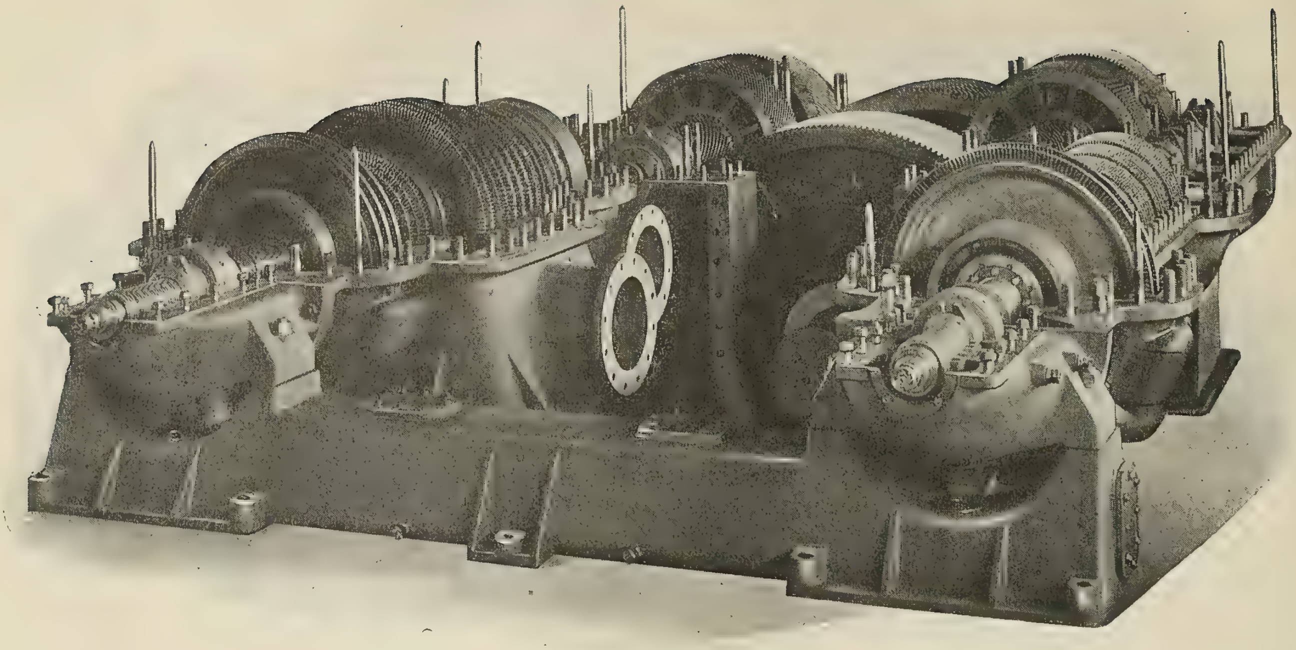


Fig. 1.—Main Engines of the *Marino Odero*, with Gear and Turbine Casings Removed

Italian Geared Turbine Cargo Steamer

Built by N. Odero & Company, at Sestri Ponenti, and Fitted with Tosi Geared Turbine Propelling and Auxiliary Machinery

THE first cargo vessel built in Italy to be equipped with Tosi geared turbine propelling machinery is the *Marino Odero*, which touched the port of New York during December on her way to Savannah. She was destined for an early return to Italian ports with a cargo of cotton. This vessel, which was completed during 1918 by the N. Odero & Company, at Sestri Ponenti, under Lloyd's supervision, is 378 feet long, 51 feet beam and 30.2 feet depth. The gross tonnage is 5,495, and the net tonnage 3,369. The general arrangement of the vessel is shown in the accompanying plans.

The Propelling Machinery

The machinery of this vessel is of special interest, since the complete equipment was supplied by the firm of Franco Tosi Company of Legnano and Milan, Italy.

The propelling machinery consists of a Tosi geared turbine unit, designed to develop a shaft horsepower of 2,100 to 3,000, with the propeller shaft turning at a speed of from 65 to 80 revolutions per minute. The unit consists of one high-pressure and one low-pressure turbine, with an astern turbine incorporated in the low-pressure casing. The reduction gear is of the rigid type, already described in the April (1918) issue of Marine Engineering.

Turbine-Driven Auxiliaries

The turbine-driven auxiliaries, consisting of the circulating pump and two boiler feed pumps, both of the centrifugal type, are also of Tosi design. The condenser is fitted with two steam ejectors of the Leblanc type to extract the air in the condensing chamber. The capacity of one boiler feed pump is 20 tons per hour, at a pressure of 265 pounds per square inch. Only one of these pumps is used in ordinary service, the other being used as a reserve; this pump is driven by a 20-horsepower steam turbine, running at 5,000 revolutions. The water circulating pump is actuated by a 50 to 60 horsepower turbine, running at 5,500 revolutions per minute. The latter drives through a reduction gear.

Pump for the Extraction of Condensed Steam

A centrifugal circulating water pump and a lubricating oil circulating pump, running at 500 revolutions per minute, are combined with a vertical centrifugal pump for the extraction of condensed steam. This pump is driven by means of a helical gear from the pump shaft.

The turbine-driven auxiliaries are reported to have operated with complete satisfaction during the 12,000 miles which the vessel has already traversed, partly in convoy and partly in free navigation. An inspection after the long run failed to show signs of corrosion in the turbines or wear on the gear wheels.

Boilers

The electric generators and blowers are driven by engines of the reciprocating type. Steam is supplied at a working pressure of 190 pounds per square inch by two three-furnace Scotch boilers. The fuel consumption is given as 33 tons per twenty-four hours, when the vessel is traveling at her normal speed of 9 to 9½ knots and the boilers are operating under the conditions for which they were designed.

In addition to the turbines mentioned above, the Franco Tosi Company are builders of steam engines, boilers, crude oil and Diesel engines and other marine equipment. They have built turbines direct-connected with the propeller shaft up to 25,000 shaft horsepower, which have been installed upon fast scout boats, destroyers and other craft of the Italian navy.

ITALIAN CARGO STEAMER MARINO ODERO OF 5,495 GROSS TONS

Built by N. Odero & Company, Senestri Ponenti. Equipped with Tosi Geared Turbine Propelling and Auxiliary Machinery

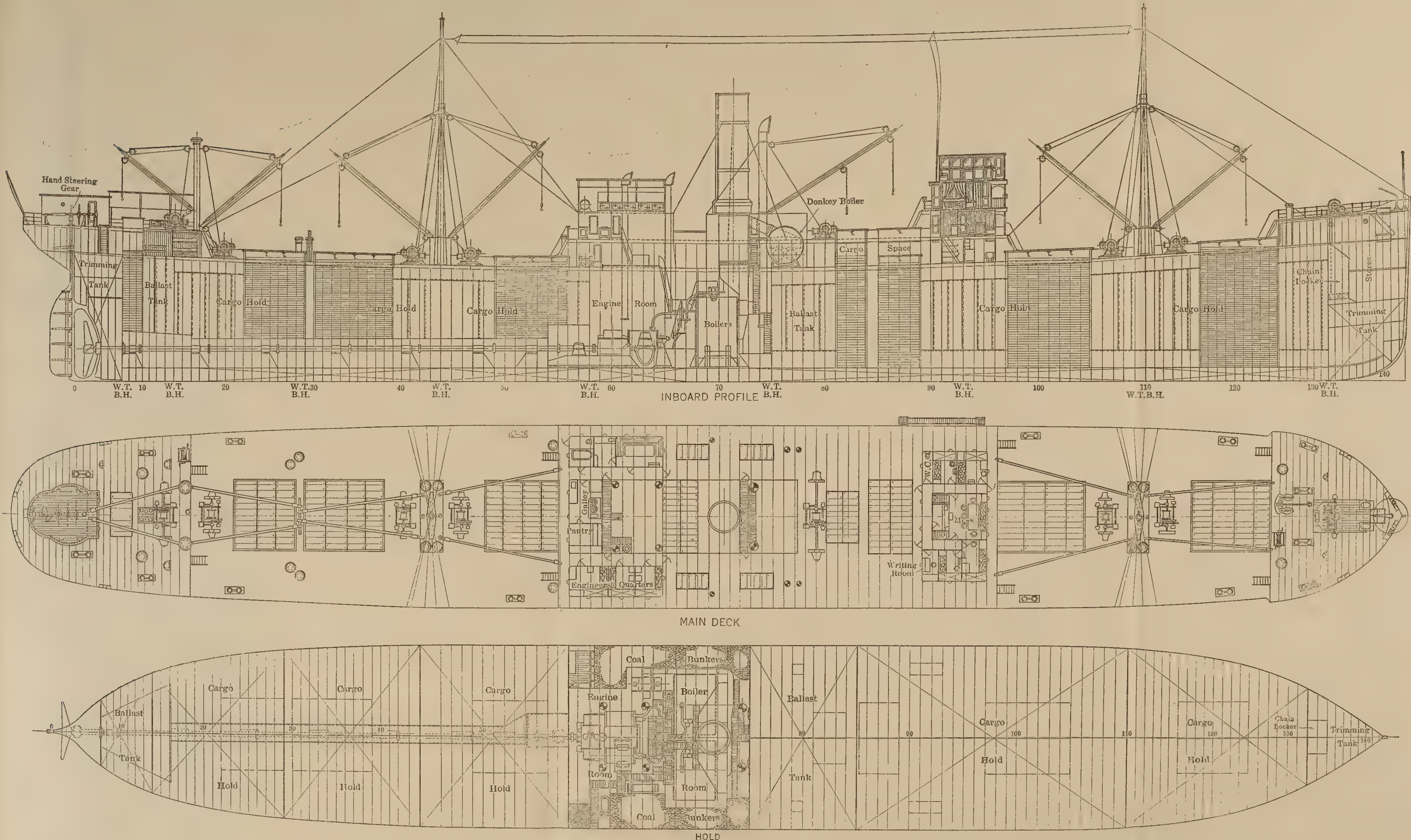


Fig. 2.—Inboard Profile, Deck and Hold Plans

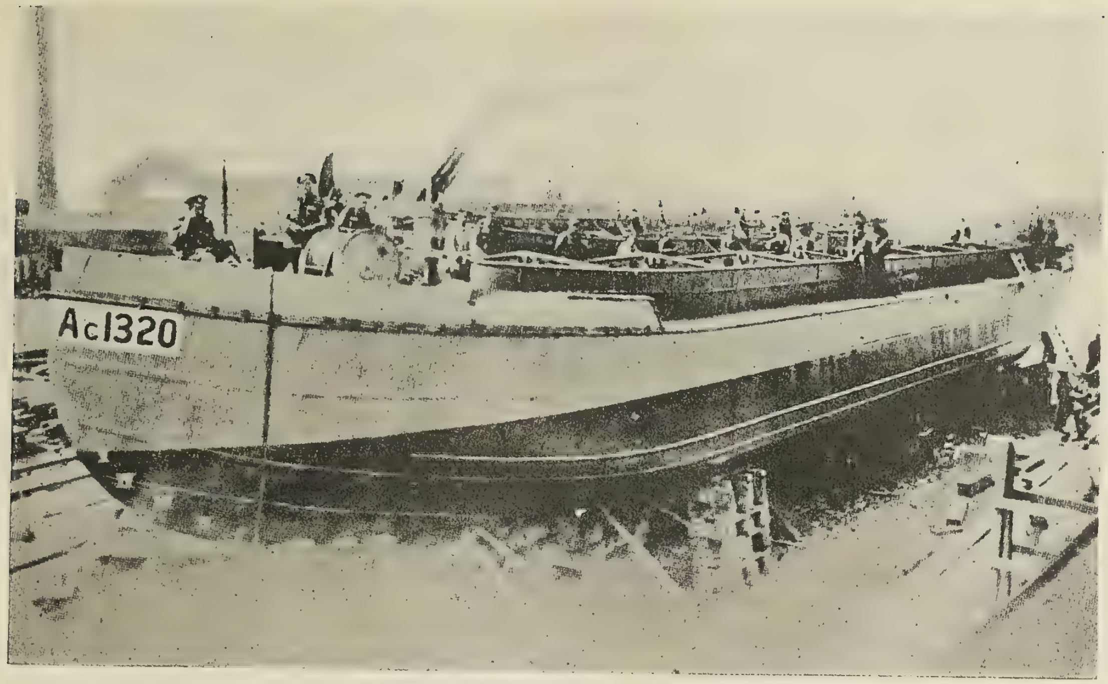


Fig. 1.—Electric Welded Barge, Built at Richborough, England

Electric Welding in Ship Construction—II*

Results of Lloyd's Tests—Tentative Regulations for Arc Welding in Ship Construction—Electrically Welded Vessels and Proposed Designs

BY H. JASPER COX

As outlined in the January issue, a series of experimental tests was devised and carried out under the direction of Lloyd's technical staff in England, extending over a period of many months, to determine the possibilities of the application of electric arc welding to shipbuilding. The following is a summary of these experimental results:

1. *Modulus of Elasticity and Approximate Elastic Limit:*

(*a*) In a welded plate the extensions in the region of the weld are sensibly the same as for more distant portions of the unwelded plate.

(*b*) With small welded specimens containing an appreciable proportion of welded material in the cross sectional area, the relation between extension and stress is practically the same, up to the elastic limit, as for similar unwelded material.

(*c*) The elastic limit (or the limiting stress beyond which extension is not approximately directly proportional to stress) appears to be slightly higher in welded than in unwelded material.

(d) The modulus of elasticity of a small test piece, entirely composed of material of the weld, was about 11,700 tons per square inch as compared with about 13,500 tons for mild steel and about 12,500 tons for wrought iron.

2. *Ultimate Strength and Ultimate Elongation:*

(*a*) The ultimate strength of welded material with small specimens was over 100 percent of the strength of the unwelded steel plate for thicknesses of ½ inch, and averaged 90 percent for plates of ¾ and 1 inch in thickness.

(*b*) Up to the point of fracture the extensions of the welded specimens are not sensibly different from those of similar unwelded material.

(*c*) At stresses greater than the elastic limit, the welded material is less ductile than mild steel, and the ultimate elongation of a welded specimen when measured on a length of 8 inches only averages about 10 percent, as compared with 25 to 30 percent for mild steel.

3. *Alternating Stresses:*

(*a*) *Rotating Specimens* (round bar).—Unwelded turned bars will withstand a very large number of repetitions of stress (exceeding, say, 5 millions) when the range of stress is not greater than from 10½ tons per square inch tension to 10½ tons per square inch compression.

Welded bars similarly tested will fail at about the same number of repetitions when the range of stress exceeds ±6½ tons per square inch.

(*b*) *Stationary Test Pieces* (flat plate).—Butt welded specimens will withstand about 70 percent of the number of repetitions which can be borne by an unwelded plate.

Lap welded plates can endure over 60 percent of the number of repetitions necessary to fracture a lap riveted specimen.

4. *Minor Tests:*

(*a*) Welded specimens are not capable of being bent (without fracture) over the prescribed radius to more than about 80 degrees with ¼-inch plate, reducing to some 20 degrees where the thickness is 1 inch. Unwelded material under the same conditions can be bent through 180 degrees.

(*b*) Welded plates can withstand impact with a considerable degree of success; a half-inch plate of dimen-

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* Concluded from January issue. Extracted from paper read at twenty-sixth general meeting of the Society of Naval Architects and Marine Engineers, Philadelphia, Pa., November 15, 1918.

sions already quoted sustained two successive blows of 4 hundredweight dropped through 12 feet, giving a deflection of 12 inches on a length of about 4 feet 6 inches without any signs of fracture in the weld.

5. *Chemical and Microscopic Analysis:*

(*a*) *Chemical Analysis.*—The electrode was practically identical with mild steel, but there was a greater percentage of silicon.

The material of the weld after deposition was ascertained to be practically pure iron, the various other contents being carbon, 0.03; silicon, 0.02; phosphorus, 0.02, and manganese, 0.04 percent, respectively.

(*b*) *Microscopic Examination.*—The material of the weld is practically pure iron.

The local effect of heat does not appear to largely affect the surrounding material, the structure not being much disturbed at about 1/16 inch from the edge of the weld. The amount of disturbance is still less in thin plates.

The weld bears little evidence, if any, of the occurrence of oxidation.

With welds made as for these experiments, *i.e.*, with flat horizontal welding, a sound junction is obtained between the plate and the welding material.

6. *Strength of Welds* (large specimens):

(*a*) *Butt welds* have a tensile strength varying from 90 to 95 percent of the tensile strength of the unwelded plate.

(*b*) *Lap Welds.*—With full fillets on both edges, the ultimate strength in tension varies from 70 to 80 percent of that of the unwelded material.

With a full fillet on one edge and a single run of weld on the other edge, the results are very little inferior to those where a full fillet is provided for both edges.

(*c*) *Riveted Lap Joints.*—For plates of about ½ inch in thickness, the specimens averaged about 65 to 70 percent of the strength of the unperforated plate.

Typical examples of the statical strength of large specimens of riveted and welded joints are given in the following table:

Treble Riveted Lap Joints

Thickness, Inches.	Diameter of Rivet, Inches.	Breaking Stress Unperforated Plate, Lbs. Per Square Inch.	Strength of Plain Plate, Pounds Per Square Inch	Percentage Strength of Joint.
0.49	⅞	42,400	61,400	69.0
0.53	¾	38,300	54,700	62.5
Lap Weld—Full Fillet—Both Edges				
0.514	10.02	45,300	63,600	71.0
0.73	8.76	40,330	59,600	68.0
Butt Weld—Not Strapped				
0.505	10.66	61,000	63,600	96.0
0.76	9.88	54,680	59,600	91.5

Observations on Experimental Results

1. *Static Elasticity.*—It will be observed that the statical tests made to determine the elasticity indicate that, in general, the combination of welded and unwelded material behaves practically homogeneously up to at least the elastic limit. Moreover, the experiments show that the process of welding is such that the stress is distributed practically uniformly over the weld and also transmitted uniformly to the adjacent plates.

The material of the weld is practically pure iron, and from the tests made on a specimen composed entirely of the deposited material of a weld it will be seen that for a given stress the weld stretches slightly more than mild steel. This property will enable any undue occurrence of load being transferred in a proper manner to adjacent portions of the structure. When, however, the stress exceeds the elastic limit and is so great that the extension grows continuously without increase of load, the welded material fails sooner than mild steel. But this disadvantage is of little practical importance in shipbuilding and may be regarded as negligible in the particular problem under consideration.

2. *Dynamic Elasticity.*—In a structure, such as a ship, which is exposed to variations and reversal of stresses, it is extremely important to know whether the material to be used is likely to break down rapidly under such alternations and ranges of stress as are likely to be experienced. The modified Wohler tests employed in the experiments certainly indicate, if considered solely by themselves, that whereas for a given number of alternations mild steel would withstand a range of stress of, say, ±10½ tons, the welded material might be expected to fail at about ±6½ tons, a figure which is more nearly experienced in ordinary ship construction.

As already stated, the material in the weld appeared to be nearly pure iron, and experiments of repetitive stress show that wrought iron bars are likely to fail under a range of stress of perhaps ±7 to 8 tons, as compared with mild steel at ±10 to 11 tons. The weld has to be deposited electrically and is subject to variations in workmanship; it would consequently be considered satisfactory if the material could withstand a range of stress of, say, ±6½ tons.

It would appear to be necessary to design the welded joints in such a manner that the amount of work likely to be thrown on the joint is as small as possible, and to meet such a condition a welded joint requires to be either lapped or strapped.

Consideration of the dynamic elasticity properties appears to show that in any case the welded material can experience as large a number of repetitions of stress as wrought iron could do, and it is always recognized that, although iron could not approach the tests for mild steel, yet it was a satisfactory material for shipbuilding purposes. Further, attention to design of details will increase the performance of the welded joint, and in addition it must not be forgotten that 5,000,000 repetitions of stress is perhaps more than equivalent to ten years' good sea service.

3. *Physical Nature and Properties.*—It has been mentioned that the welds experimented with are to be regarded as having been produced under most favorable conditions, and that throughout the experimental welds were made with the specimens horizontal and below the operator. In practice, welds will require to be made vertically and overhead as well, consequently extreme care will be required in such operations.

The physical examinations indicate that the materials of the electrode and the system of welding adopted were suitable and reliable. Moreover, there was little apparent oxidation, and the material in the neighborhood of the weld was not affected to any prejudicial extent.

4. *Strength of Welds and Minor Tests.*—Broadly speaking, the tensile strength of butt welds was as great as the unwelded material, but it is considered that greater reliability of workmanship is obtained with joints which are either lapped or strapped. It was also found that the lapped joint was practically as strong as a riveted lapped joint and would probably remain tight when subjected to more trying conditions than are necessary to disturb a riveted lap joint.

It will be seen therefore that the arc-welded joints made

by highly skilled workmen with the particular system adopted throughout the foregoing experiments (the quasi arc process using flux covered electrodes) proved not only reliable but in some respects superior to the usual riveted joint. In view of the satisfactory results of these tests, the Committee of Lloyd's Register of Shipping has decided that, under certain conditions, electric arc welding may be used in the main structure of a vessel and have adopted as a tentative measure the following provisional rules for classification in Lloyd's Register Book of vessels electrically welded, subject to the notations "Experimental" and "Electrically Welded." The approval of the Society will be given to any system of welding which complies with these regulations, and consideration will be given to any alternative constructional arrangements which may be submitted for approval.

Tentative Regulations for the Application of Electric Arc Welding to Ship Construction

A. System of Welding and Workmanship

1. The system of welding proposed to be used must be approved and must comply with the regulations and tests laid down by the committee.

2. The process of manufacture of the electrodes must be such as to ensure reliability and uniformity in the finished article.

3. Specimens of the finished electrodes, together with specifications of the nature of the electrodes, must be supplied to the committee for purposes of record.

4. The committee's officers shall have access to the works where the electrodes are manufactured, and will investigate, from time to time as may be necessary, the process of manufacture to ensure that the electrodes are identical with the approved specimens.

5. Alterations from the process approved for the manufacture of electrodes shall not be made without the consent of the committee.

6. The regulations for the voltage and amperage to be used with each size of electrode, and for the size of electrode to be employed with different thicknesses of material to be joined, are to be approved by the committee.

7. The committee must be satisfied that the operators engaged are specially trained, and are experienced and efficient in the use of the welding system proposed to be employed.

8. Efficient supervisors of proved ability must be provided, and the proportion of supervisors to welders must be submitted for approval.

B. Details of Construction

9. The details of construction of the vessel and of the welds are to be submitted for approval.

10. Before welding, the surfaces to be joined must be fitted close to each other and the methods to be adopted for this purpose are to be approved.

11. All butt and edge connections are to be lapped or strapped.

12. With lapped connections, the breadths of overlaps of butts and seams and the profiles of the welds are to be in accordance with the following table:

Thickness of Plate, Inches	Width of Overlap Seam and Butt, Inches	Throat Thickness, Inches
0.40 and under	2¼	.28
0.60 and under	2½	.38
0.80 and under	2¾	.48
1.00 and under	3	.50

Intermediate values may be obtained by direct interpolation, and for thicknesses below 0.40 the throat thickness is to be about 70 percent of the thickness of the plate.

13. A "full weld" extends from the edge of a plate for a distance equal to the thickness of plate to be attached, and the minimum measurement from the inner edge of plate to the surface of weld is the throat thickness given in the table above.

14. A "light closing weld" is a single run of light welding worked continuously along the edge of the plate. Such a weld may, however, be interrupted where it crosses the connection of another member of the structure.

15. An "intermittent or tack weld" has short lengths of weld which are spaced three times the length of the weld from center to center of each short length of weld. Such tack welding may vary in amount of weld between a "full weld" and a "light closing weld."

16. The general character of welds is to be in accordance with the following table:

	Inside Edge	Outside Edge
(*a*) Butts of shell, deck and inner bottom plating (*b*) Butts of longitudinal girders and hatch coamings	F	F
(*c*) Edges of shell, deck and inner bottom plating (*d*) Butts and edges of bulkhead plating	L	F
	Toe	Heel
(*e*) Frames to shell, reverse frames to frames and floors (*f*) Beams to decks (*g*) Longitudinal continuous angles (*h*) Side girders, bars to shell, intercostal plates, floors and inner bottom (*i*) Bulkhead stiffeners	T	L

F = full weld. L = light weld. T = tack weld.

17. All bars required to be watertight are to have continuous welding on both flanges with tack welding at heel of bar.

18. The welded connections of beam, frame and other brackets are to be submitted for special consideration.

19. The committee may require, when considered necessary, additional attachment beyond that specified above, and the welding of all other parts is to be to their approval.

The rules are necessarily of a tentative nature and general in character and will be modified as further experience demands. It will be observed, however, that considerable importance is attached to the system of welding, type and process of manufacture of electrode, and to the employment of specially trained operators under supervisors of proved ability.

Electrically Welded Vessels

The first vessel to be electrically welded so far as the writer is aware was the *Dorothea M. Geary*, a small launch 42 feet by 11 feet by 6 feet 6 inches, built by the Geary Boiler Works at Ashtabula Harbor, Ohio, in 1915. The shell, which is of 8-pound plating, is electrically welded throughout, the joints being butted, and metallic arc bare electrode used. The frames and bar keel are riveted to the shell. This little boat has been in service in the harbor since her completion, and no signs of distress or leakage have yet been noticed in any of the welded joints.

The Richborough Barge.—The barge recently completed at Richborough on the southeast coast of England, and referred to in the daily press as "the first rivetless ship," has attracted widespread attention. The construction of this barge was the sequence to a long series of successful tests on electrically welded joints carried out in England at the Admiralty dockyards and elsewhere, and will doubtless prove to be the stepping stone between the laboratory test stage and an actual full-powered ocean-going steamer yet to be built.

The barge is a non-propelled standard cross-channel transport barge, 125 feet between perpendiculars and 16 feet beam, with a displacement of 275 tons. It differs in

no way from the standard riveted type with lapped joints, excepting that the seams of shell plating are arranged clinker fashion and joggled to permit of horizontal downward welding as much as possible. The hull is rectangular in section amidship, with only the bilge plates curved. The shell plates are ¼ inch and 5/16 inch thick.

It was erected in the ordinary manner with service bolts spaced from 10 inches to 15 inches apart, and after the joints were welded the bolts were removed and pins driven into the holes and welded up, as it was desired to complete the structure entirely without rivets.

Five welders of considerable experience were employed on the work, using the "Quasi Arc" process with flux covered electrodes. After a few initial difficulties had been overcome, an average speed of welding of 7 feet per hour was maintained, including overhead work, which averaged from 3 to 6 feet an hour. Altogether there were from 7,000 linear feet of welding and 3,066 holes to be filled, the total cost of welding, which was $14,400 (£300), made up as follows: Electrodes, $855 (£178); current, $288 (£60); labor, $297 (£62), a total of $14,400 (£300). It is anticipated that the large proportion of this amount, represented by cost of electrodes, could be reduced by some 60 percent with an increased output.

Careful check was kept of the total cost and the total man-hours of work involved, but a comparison with that of a similar riveted barge would be misleading, since the welded vessel was purely an experimental demonstration and no attempt was made to save material or to economize by the substitution of rivets in parts where this might have been cheaper or quicker than welding. Nevertheless, it is estimated that 246 man-hours were saved over the riveted barge.

Since her completion she has been engaged in cross-channel service, and with a full cargo of ammunition has experienced some exceptionally heavy weather, but has so far shown no signs of failure in the electrically welded joints.

A. J. Mason's Experimental Section.—With the object of trying out on full scale several methods of electric welding, Mr. Mason, of the United States Shipping Board, is having constructed at the Federal Shipbuilding Company's yard, Kearney, N. J., a 46-foot length of the full-size middle body section of one of the standard 9,600-ton deadweight vessels. Owing to the difficulty in securing material, some departure has been made from the regular scantlings, and ordinary tank quality steel is being used. It is proposed to employ a variety of different methods of connection, including riveting, in the different parts, and a serious attempt will be made to apply the portable spot welder, previously referred to, both for clamping and welding.

In this work, Mr. Mason is collaborating with the Welding Committee, and it is expected to derive considerable information of a practical nature during the erecting and welding of the structure by different systems. The section is arranged so that on completion it may be filled with water and subjected to hydraulic and such other tests of a practical or scientific nature which may be suggested.

Designs for Welded Ships

Two significant points to bear in mind in designing an electrically welded vessel, for the present at any rate, are, first, that we do not know all there is to know about a welded joint, and, secondly, a welded joint has not yet been produced which is 100 percent efficient in all respects as compared with the parent material united. With reasonable precautions it is comparatively easy to obtain a tensile strength at least equivalent to the metal united, but tension is only one of the many stresses to which such structures are subjected. It is not so easy to reproduce the same degree of ductility, the resistance to fatigue and to combined stresses of various kinds.

In preparing the design and arrangement of material for a welded ship, it is considered desirable to keep the following practical features in view:

1. The work has to be properly closed up for welding.
2. Overhead welding should be reduced to a minimum.
3. As much welding as possible should be done on the ground or in the shops, where the material can be handled in the most favorable positions and where the discomforts and inconvenience of protective equipments are least felt.
4. In certain parts riveting may be more convenient and economical than welding.

Longitudinally Framed Electrically Welded Vessel—J. W. Isherwood has designed an electrically welded vessel on the Isherwood system of ship construction. The dimensions are 303 feet length between perpendiculars, 42 feet 9 inches beam molded, 23 feet 4 inches depth molded, and about 3,960 tons deadweight carrying capacity. The arrangement of material and scantlings is much the same as in a riveted vessel of the same type, and apparently the designer has given full consideration to the practical limitations in ship construction, as well as to the limitations demanded by our present knowledge of electric welding.

The seams of side plating are arranged clinker fashion, and as many attachments as possible are welded to the shell decks and inner bottom plating before erection in order to reduce the amount of overhead welding. In fact, from a close study of the design, it will be seen that overhead welding is practically avoided altogether in the case of the strength welds.

The shell plates in this design are 84 inches in width and each plate has three longitudinals welded to it before erection, the butts of the longitudinals being welded at or near the butts of the shell plate. The system of construction lends itself to a large proportion of the total welding being done prior to erection, and in working out the details no attempt has been made towards an unreasonable elimination of bolting or riveting. For instance, the longitudinals are attached to the shell plating by service bolts spaced 12 inches apart and are welded at the toe and heel by continuous light welds; then the bolts are removed and rivets or welded studs fitted. In other parts, where the minimum number of bolts necessary to properly tighten up the work approaches the total number of rivets required in the riveted ship, the designer has simply added the extra rivets instead of attempting to weld.

This vessel has been designed in general conformity with the Rules of Lloyd's Register of Shipping for electrically welded vessels, and instructions have already been issued by the Director of Shipbuilding in Great Britain to proceed with the construction of a number of coastal vessels of about 200 feet in length after this design, and the 303-foot vessels will probably be commenced shortly.

Transversely Plated Vessel—It may be found desirable and expedient to break away entirely from the present methods of erection and of arranging material for which the limitations of a riveted joint have been primarily responsible. That such an eventuality has been foreseen is evidenced by a design and method of erection devised by Mr. C. P. M. Jack, acting under the direction of the Electric Welding Committee. In this design one of the principal objects aimed at was the fabrication and welding of large sections in the shops with a view to reducing overhead and field welding. With the exception of the

keel, center keelson, rider, bilge and sheer strakes and upper deck stringer, the vessel is plated transversely. The parts mentioned are those subjected to the maximum principal stresses and are worked fore and aft in long lengths of increased thickness, the butts being shifted and specially reinforced.

The method of erection proposed is also a radical departure from existing methods. Instead of building from the keel upwards, this vessel is built from the stern forward. A large header—mounting two electrically driven cranes and containing the stagings, pipe fitters', joiners', carpenters', and other shops, welding equipment, and foremen's offices necessary—for each ship travels along the way on tracks as each 6-foot section is completed.

The design was adapted to standardized production and arranged so that a complete section 6 feet in length could be erected and welded at the ship each 8-hour shift. It was intended that the shop work be done entirely by women and the field erecting and welding by men.

Tosi Turbine-Driven Auxiliaries

STEAM turbines of simple design have been developed by the firm of Franco Tosi, of Legnano and Milan, Italy, for the purpose of driving auxiliary machinery in the engine rooms of steamers. When applied to blowers, feed pumps, circulating pumps and electric generating sets, these turbines are found to be economical in operation.

Capacity of Tosi Air Blower

In manufacturing the blower units, the turbine and blower are coupled together in compact form to simplify installation. These turbines, which are built for a working pressure of 200 pounds per square inch, may be operated with equal success with open exhaust, attached to the condensing chamber, or fitted with an exhaust pipe which furnishes a back-pressure of 20 pounds per square inch. Normal operating power is produced with a steam pressure of 140 pounds per square inch, and the turbine will accommodate an overload of at least 10 per cent. Fixed on tapered bases with tie rods, turbo-blowers of the vertical shaft type can be installed as a complete unit from the deck of the vessel. Deformations of the hull, therefore, cannot interfere with the operation of the blower. On account of the vertical division of the turbine frame, the turbine can be opened for inspection by simply loosening a few bolts without the use of special tools.

The blower, which is also built at the Tosi factory, is of the radial type, with taper-shaped blades at entrance and exit. The method of introducing the air horizontally into the boiler rooms produces very slight deviation. In specific installations the blower was run at a speed of

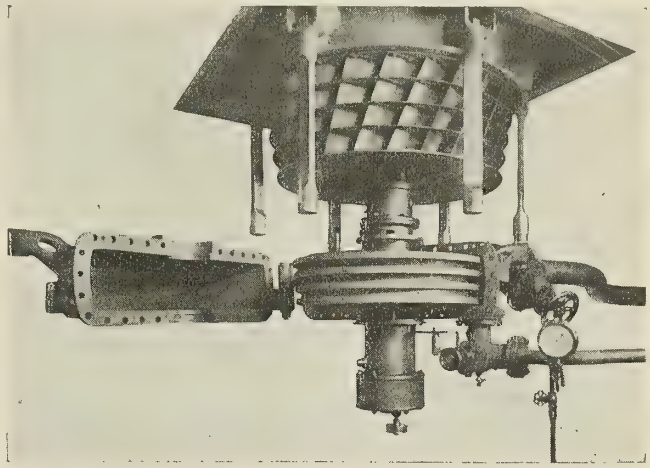
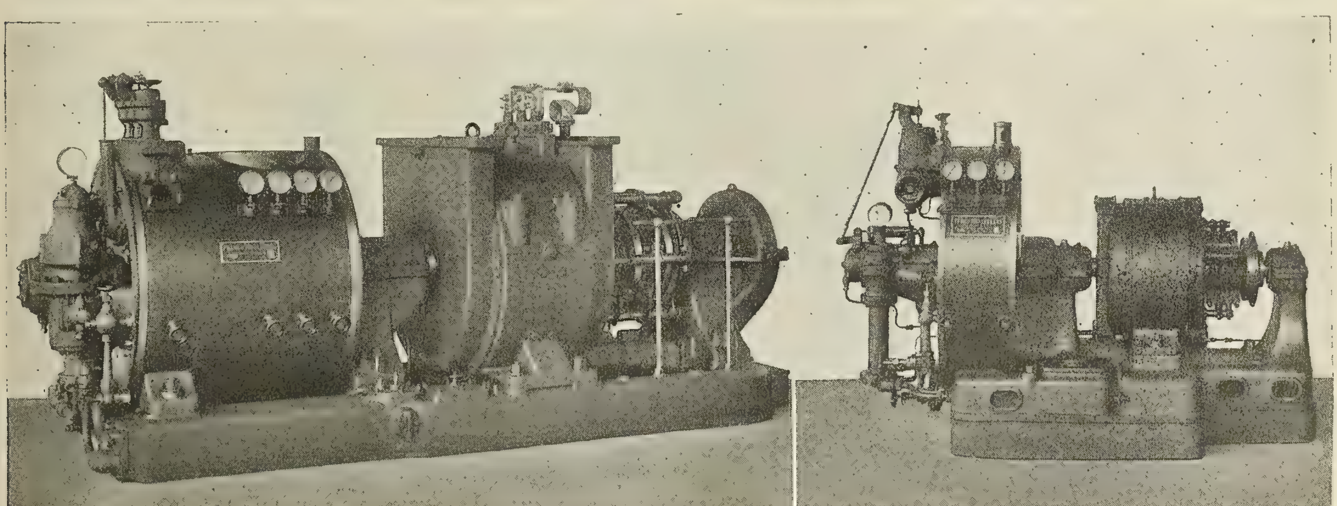


Fig. 1.—Steam Turbine for Driving Blowers Showing Simple Manner of Opening Parts for Inspection

1,500 to 1,800 revolutions per minute, with maximum air capacity of 565 to 1,130 cubic feet per second, with an air pressure of 6½ inches of water. The admission of steam is regulated by hand by means of a throttle valve. Should the turbine speed exceed 15 per cent of the normal rate, an automatic safety valve immediately shuts off the steam. For vessels of smaller type a blower of 13-horsepower has been designed which runs at the rate of 1,500 to 6,000 revolutions per minute, with a capacity of 200 cubic feet at the same working pressure as the blower of greater capacity.

Turbines For Electric Generating Sets

The weight and size of the steam turbines used for electric generating sets have been reduced to a minimum in the Tosi design. The construction of all Tosi turbines, for this purpose, which range in size from 25 to 300 kilowatts, is the same except for the blade development, which is increased for the sizes producing over 100 kilowatts.



Figs. 2 and 3.—Types of Steam Turbine Electric Generating Sets. The Larger Unit Produces 300 Kilowatts. Except for Greater Blade Development in Units Over 100 Kilowatts, the Turbine is the Same. The Smaller Unit Produces 30 Kilowatts

Types of large and small units are illustrated in Figs. 2 and 3. Complete forced lubrication systems are installed with oil cooler and circulating pumps, replacing the older ring lubricating systems.

The dimensions of the Tosi turbine are such that the operating unit can carry a heavy overload as well as reduced steam pressure. Saturated or superheated steam may be used. Control valves for inlet steam are provided in the first wheel. All Tosi turbines are fitted with governors.

Automatic Overload Valve

As a further safeguard, the larger units are fitted with an automatic overload valve, controlled by an oil servomotor.

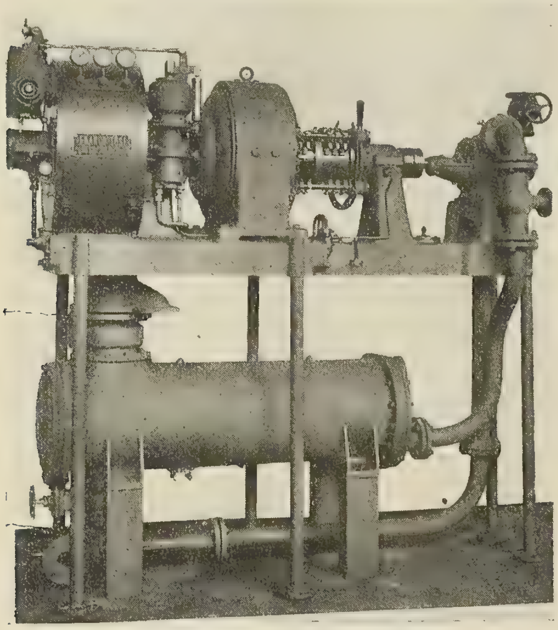


Fig. 4.—Turbine-Driven Condenser Pump, Generator Unit and Circulating Pump

The electric generators, usually of the direct-connected type, work without spark, even under very rapid change of load. Tosi turbine-driven dynamos are usually built so that one main condenser serves all auxiliaries. In cases where it has seemed preferable, each single set has been provided with its proper condenser. These generating sets are built in units, consisting of a generating set, condensers and circulating pumps for cooling water, as illustrated in Fig. 4. In these units, air pumps have been replaced by hydraulic ejectors, which provide for the elimination of all gaseous products from the condensing chamber.

Unit Group Construction

Turbines for water circulating, boiler feed, and oil circulating pumps, which are made in all current sizes and pressures, drive these pumps directly. To save floor space and simplify operation, all the necessary pumps for the condensing plant are incorporated in one unit group, which is driven by one turbine. The latter is actuated by a reduction gear which operates at a speed of 500 revolutions per minute. A centrifugal water circulating pump, with a 90-ton capacity and maximum pressure of 8 pounds per square inch, and a lubricating oil circulating pump, which furnishes the whole lubricating system of the main propelling machinery, are also included in the unit group construction.

Boiler Feed Turbo-Pumps

In addition, a vertical centrifugal pump, driven by means of a helical gear from the pump shaft, is provided for the extraction of the condensed water (Fig. 6). In Fig. 5 is illustrated a type of boiler feed turbo-pump which runs at the rate of 3,200 revolutions per minute. This pump has a capacity of 120 tons of water per hour, at a pressure of from 250 to 280 pounds per square inch. For smaller vessels, similar designs of turbo-pumps are built with capacities of 24 tons per hour and up.

Tosi Turbines Installed on Italian Naval Vessels

Reports from many of the vessels in the Italian Navy, where these turbine units have been installed, show that they have been operated with marked success in heavy war service. Exact measurements, taken during official tests at the Tosi shops, relating to the steam consumption of these turbines when driving blowers and dynamos, indicate that the fuel consumption for Tosi turbines is about 25 per cent less than that recorded for other types of steam turbines installed upon navy vessels. Practically the same working conditions are obtained in the shop tests as are found in actual operation on board ship.

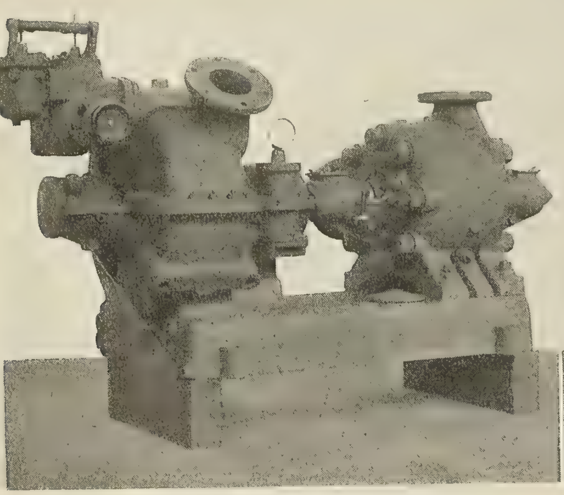


Fig. 5.—Turbine-Driven Boiler Feed Pump Having a Capacity of 120 Tons of Water per Hour at a Pressure of 250-280 Pounds per Square Inch

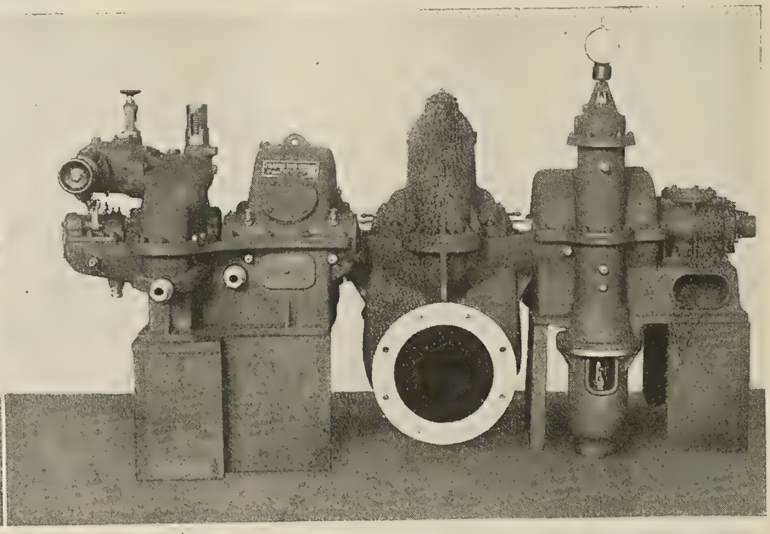


Fig. 6.—Steam Turbine for Driving a Lubricating Oil Circulator Pump and a Vertical Centrifugal Pump to be Used in the Extraction of Condensed Water

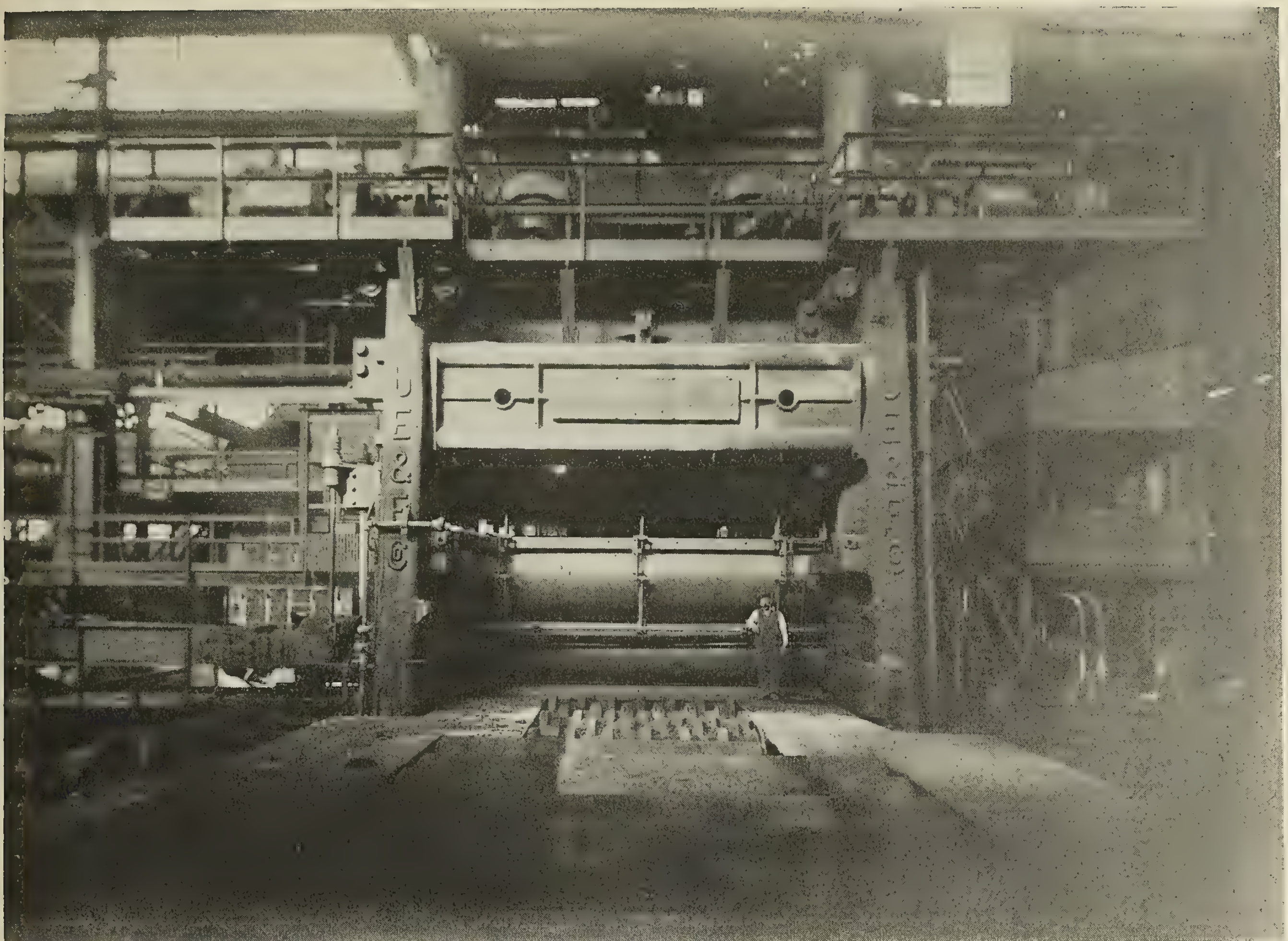


Fig. 1.—Showing Rolls of 4-High Reversing Type of Mill. The Two Cast Iron Working Rolls, 34 Inches in Diameter, Weigh 20 Tons Each. The Backing Rolls, 50 Inches in Diameter, of Cast Steel, Weigh 60 Tons Each

Lukens New Plate Mill Largest in the World

Of 4-High Type With Rolls 204 Inches Wide—New Mill Will Roll 5,000 Tons of Plate Per Week—Six Furnaces Added to Steel Plant

THE Lukens Steel Company is now operating a new 204-inch mill, which not only exceeds any unit in the United States, but also anything in any other country in the world. This mill, a 4-high reversing type, is capable of rolling plates up to 192 inches in width and circles a few inches wider.

Design of the New Mill

The new mill is built on the principle of the 2-high reversing plate stand commonly used in the British Isles, with a modification, viz., that the two finishing rolls are backed by two large supporting rolls. The purpose of these latter rolls is to stiffen the mill and to give it the added strength necessary to prevent springing of the operating rolls when rolling wide, thin plates, thus insuring uniform thickness in the finished product. This arrangement also enables the use of operating rolls of smaller diameter, and thereby overcomes the difficulties of obtaining chilled rolls of the size which would be required in a 3-high mill of this extreme width. There are two 34-inch diameter by 204-inch working face operating rolls of chilled iron with 27-inch necks weighing about 30 tons each, and two 50-inch diameter backing rolls of cast steel with 36-inch necks, weighing about 60 tons each.

The housings of the mill are of steel and are built up in four parts, consisting of two side pieces—a top bridge piece containing the screw box, and a bottom bridge piece in which is located the seat for the bottom rolls. This novel method of construction is necessitated by the unusual size of the housings, which preclude their being cast in one piece, since their machining and transportation in such form would be impossible. Each housing thus built up weighs over 400,000 pounds. The mill stands about 40 feet from the top of the screw cover to the bottom of the shoes, and its overall dimensions are slightly over 42 feet. The housing shoes are spread 16 feet 9 inches between centers and are of special design with extra large bearing surfaces.

The foundation of the mill is of concrete built on solid rock. The mill pinions are of cast steel and have double helical cut teeth, 42-inch pitch diameter by 60-inch face. The bottom pinion is connected to the engine jack shaft by a finely machined leading spindle of the universal type. This leading spindle is so arranged that it can be quickly removed and a slow-motion turning rig slid in place to be used in dressing the 50-inch backing-up rolls. The mill has a slack-up of 40 inches.

The mill is driven by a 46 by 70 by 60-inch twin tandem

compound condensing engine, fitted with a jack shaft and a gear ratio of one to two, which renders it capable of giving an enormous torque for rolling wide plates.

Process of Rolling the Plates

The mill is fully equipped with tables so arranged as to do away with hand labor wherever possible. The ingots are received from the furnaces by a hydraulically operated ingot tilter, from which they go to the approach table, and from there to the mill tables. The approach table is about 40 feet long; the mill tables are of about equal length. Each mill table consists of ten cylindrical rollers and five disk rollers. These rollers are driven by cut gearing, and the bearings and gearings are flood lubricated by an oil-pumping system, which is installed in duplicate. These tables are equipped with mechanical appliances for handling large plates, so that it is not necessary for them to be touched by hand power, as is usually the case in other present-day mill practice.

Cut-Off Shear with 210-Inch Gap

After inspection, the plates proceed to the shear run-out table through the cut-off shear, which is hydraulically operated and has a 210-inch gap. The cut-off shear is located in the shearing building, as is also the side shear, which is of the same size, and the necessary scrap shears. Between these shears are located tables specially designed by C. L. Huston for the handling and turning of wide, long plates. These take the place of the usual caster roller arrangement, avoiding hand labor. Another set of transfer chains carry the plates sidewise to the shipping building, where they are weighed and loaded.

Since it is possible to roll ingots up to 60,000 pounds in weight, all the machinery is constructed with a view of handling these heavy plates. These large plates are rolled direct from the ingots, but, since this has always been the practice in the Lukens plant, no serious trouble is experienced from this. When the mill is operating at its full extent, it is estimated that it will have a rolling capacity of 4,000 to 5,000 tons per week. The new mill is known as the No. 5 mill and is located parallel to the present 140-inch 3-high plate mill. The position of the two mills and the arrangement of the tables permit easy transfer of hot ingots between these two units by means of a transfer buggy. By this arrangement, ingots can be drawn from the No. 5 mill and rolled in the 140-inch mill, or vice versa.

New Steel Plant to Furnish Material

To supply the increased metal to operate the new mill, an additional steel plant comprising six basic open hearth furnaces of 100 tons each has just been finished. There is room for two more furnaces, work on which has been started. Including this group of eight furnaces, which presents a distinct open hearth installation, the Lukens plant will consist of twenty-three basic furnaces and one acid furnace. The estimated annual capacity will be about 500,000 tons of finished plates.

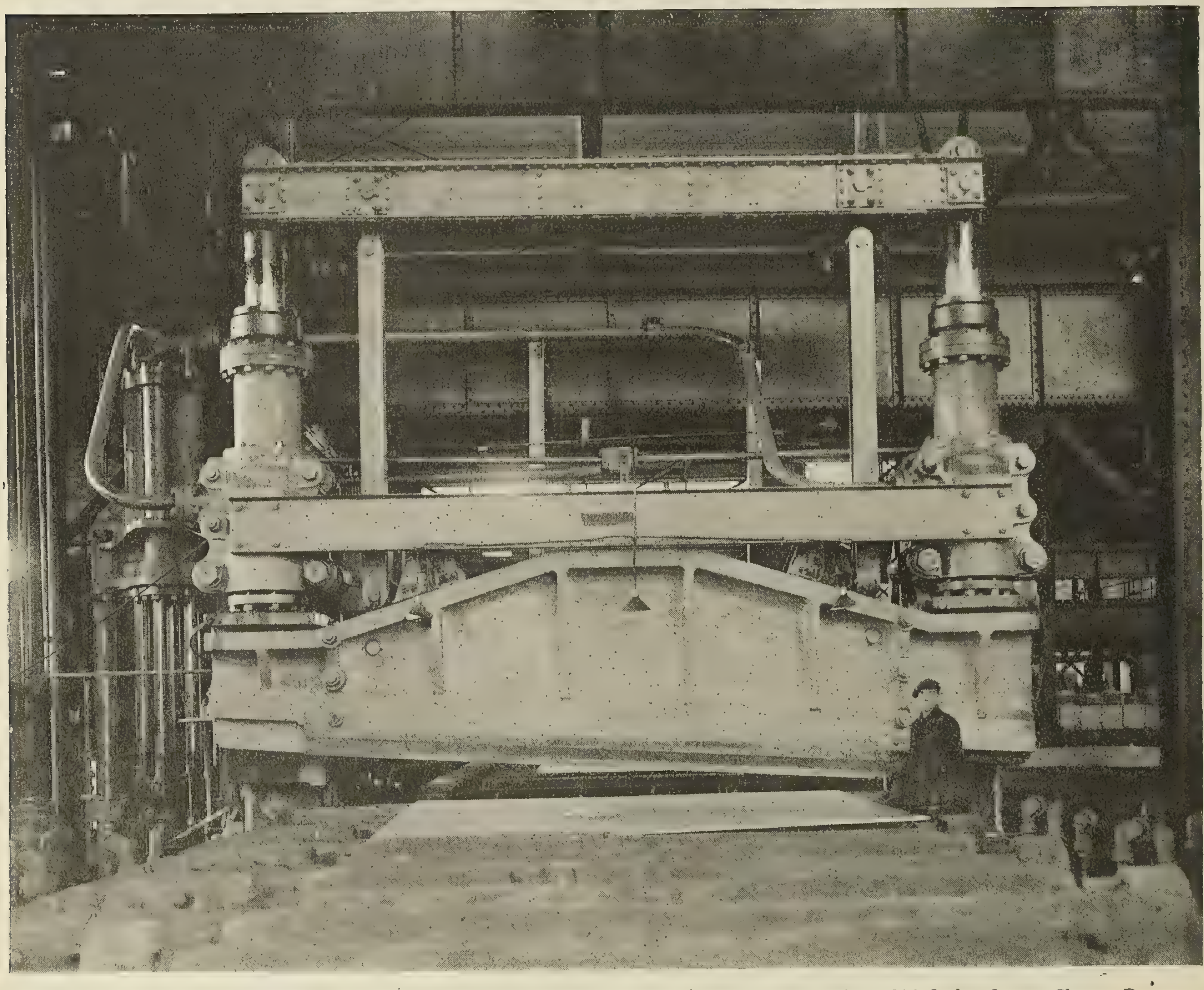


Fig. 2.—View of Hydraulic Shears Capable of Shearing Material 2 Inches Thick. The Knife is 215 Inches Long; Shears, Between Housings, 210 Inches

Fig. 1.—The Steamship *Araby* When Partly Salvaged

Interesting Salvage Work

An interesting piece of salvage work was recently completed by the Salvage Section of the British Admiralty. The steamship *Araby*, of about 3,300 tons register, bound from the Argentine with a cargo of oats, ran aground on the French coast on December 21, 1916. The vessel was refloated on December 23, and while being assisted into a harbor, then very busily engaged on war service, the towing hawsers parted. The forepart of the steamer ran up on to one of the harbor piers, and the after end on the other pier, causing the ship to become firmly fixed fore and aft athwart the harbor entrance. A few hours later the steamer broke her back near the stokehold bulkhead. The stokehold, engine room and No. 2 hold filled rapidly, and the water also gained access into Nos. 3 and 4 holds. The vessel's decks, with the exception of the poop and forecastle decks, were submerged at high water.

Ship Breaks in Two

In view of the great national interest involved, salvage operations were commenced immediately, the wreck being subsequently lifted partially by camels and partially by pumping, and taken up harbor. The *Araby* then broke in two, being held together only by a few deck plates, etc. These plates were cut apart by oxy-acetylene gas, and, the two halves filling, they settled down on an even keel. By January 18, 1917, both halves were refloated and beached each side of the harbor clear of all traffic.

Pending opportunity to remove the two portions of the wreck they were allowed to lie in this position until last summer, when the space occupied by the wreck was required urgently by the military authorities. Steps were then taken to remove the wreck. In the meantime the two halves of the vessel had been made watertight by the erection of concrete bulkheads at the after end of the fore-hold and the fore-end of the after-hold.

Rebuilt on the Thames

In July the two halves were prepared for sea. By August 15, both halves were refloated, and were towed across the Channel to a repairing yard on the Thames, where preparations subsequently were made to reconstruct the ship.

German Camouflaging

BY CARL E. PETERSON

With the armistice signed and censorship on the less important factors of the war removed, interesting facts about German methods of warfare are continually coming to light. In the accompanying illustrations are shown for the first time measures which were taken by German officers to camouflage German merchant vessels. This may be considered an unusual feature of the deceptive art of camouflage as it was practiced.

Fig. 1 shows a merchant vessel which has been so successfully handled that at a distance it almost appears like a square block. As may be noted, the smoke stack and masts have been cut down to a minimum and the open spaces which would appear between the bow, the foremast and the smoke stacks have been filled in with canvas. The position of the canvas at the after part of the vessel is arranged to simulate an old Dutch sailing vessel.

Profile Disguise

An interesting disguise, which was placed fore and aft to dim the exact outlines of the ship, is shown in Figs. 2 and 3. This consisted of a boom which was fitted with lengths of manila rope hung from the guys at regular intervals. This device made it possible to blend the vessel into the horizon so that it had little or no visibility at a very slight distance.

Probably the cost of fitting out this type of camouflaged vessel and the questionable practicability of the design prevented further adoption of this method, since few

Fig. 1.—German Vessel Camouflaged by Cutting Down Masts and Smokestack and Filling in Profile with Canvas

Fig. 2.—Rope Curtain Aft to Destroy Visibility of Ship Profile

Fig. 3.—Rope Curtains at the Bow of the Ship to Break the Hard Lines of the Profile

other ships carrying German seamen are known to have used this type of camouflage.

Side-Launching of Concrete Barges at the Aberthaw Yard

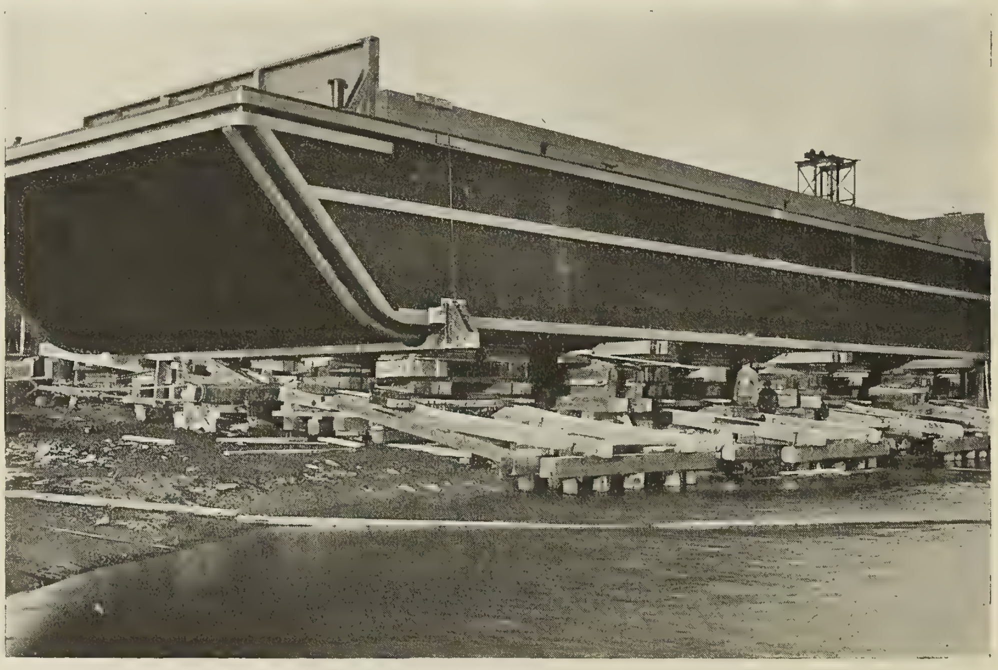
The side-launchings on December 7 and 21 of concrete vessels built at the Aberthaw Construction Company's shipyard, Providence, R. I., mark a departure in the history of New England shipbuilding. Only once before has the method been employed in this section of the country. The comparatively shallow depth of the water in front of the launching ways and the possibility of more economical handling of concrete work with the adoption of side launching, determined the engineers in their choice of this rather unusual method.

Details of the Construction of the Ways

The four launching ways of 12-by-12-inch yellow pine, built at medium high-water level, with the outer ends just awash at high tide, were set at an incline of 1½ inches in 12 inches. These ways rested on sills laid in trenches in the ground, the outer ends being supported on piling. Each pair of ways, the outside measurement of which was 9 feet, were set at an interval of 24 feet between centers. Across each pair of ways, under each longitudinal bulkhead in the lighter, and under the center of each watertight compartment, was placed a slider carrying the wedges and blocking.

The outer unit of each pair of ways, at either end of the lighter, constituted the trigger way. This was extended to the rear and capped with a piece of yellow pine to afford a bearing surface for the base of the jacks used to "start" the vessel on the ways. The trigger ways were reinforced by two one-inch round steel bars, fitted with turnbuckles and running back to deadmen, which also served as anchors for the blocks and tackle which formed part of the releasing gear.

At either end, under the lighter, and outside of the trigger ways, was placed a shoe of 10-by-10-inch yellow pine, fitted at one end with an eye at the other, with a lip, which set against the bilge of the lighter, holding it on the ways after it had been lowered to launching position. A half-inch wire rope ran up to the deck of the lighter from either end of the shoe, holding the latter snugly in place. A strut ran from a recess in the under side of the shoe to the inner end of the trigger bar, a piece of oak 10 inches by 10 inches. The outer end of this was strained back by a 6-inch manila rope, doubled and made taut by a block and tackle running to the deadman in the rear of the launching way. The block was connected to the 6-inch cables by a double strand of 4-inch manila rope which passed over the cutting block. On the other side of the trigger, and just inside of the strut, was placed a dog shore, 8 inches by 8 inches, which butted against the piling on the outer end of the launching way. Directly



View of Concrete Barge Ready for Launching at Providence Yard, Showing Construction of Launching Ways

under the side of the lighter and resting on the launching ways was a tumbling block, beveled at either end, which fell clear when the vessel started down the ways.

THE LAUNCHING

After the form work had been removed, the barge was lowered with building movers' jacks to the blocking on the sliding ways, where it was kept in place by the shoes until the releasing gear was severed simultaneously at the cutting blocks. As noted above, the strain was taken by the manila cables attached to the trigger bars, and the deadman in the rear of the trigger ways. The resistance of the vessel as she struck the water broadside was sufficient to arrest the momentum, no rope stops being necessary.

These concrete lighters of 500 tons burden are 112 feet over all, of 34-foot beam and 11 feet 6 inches deep; the draft, when the lighters are empty, is 3 feet 9 inches. The Aberthaw Construction Company has under way plans for the construction of 1,000-ton barges. The building of self-propelled concrete vessels at the Providence yard is also contemplated.

New Method of Erecting Marine Reciprocating Engines

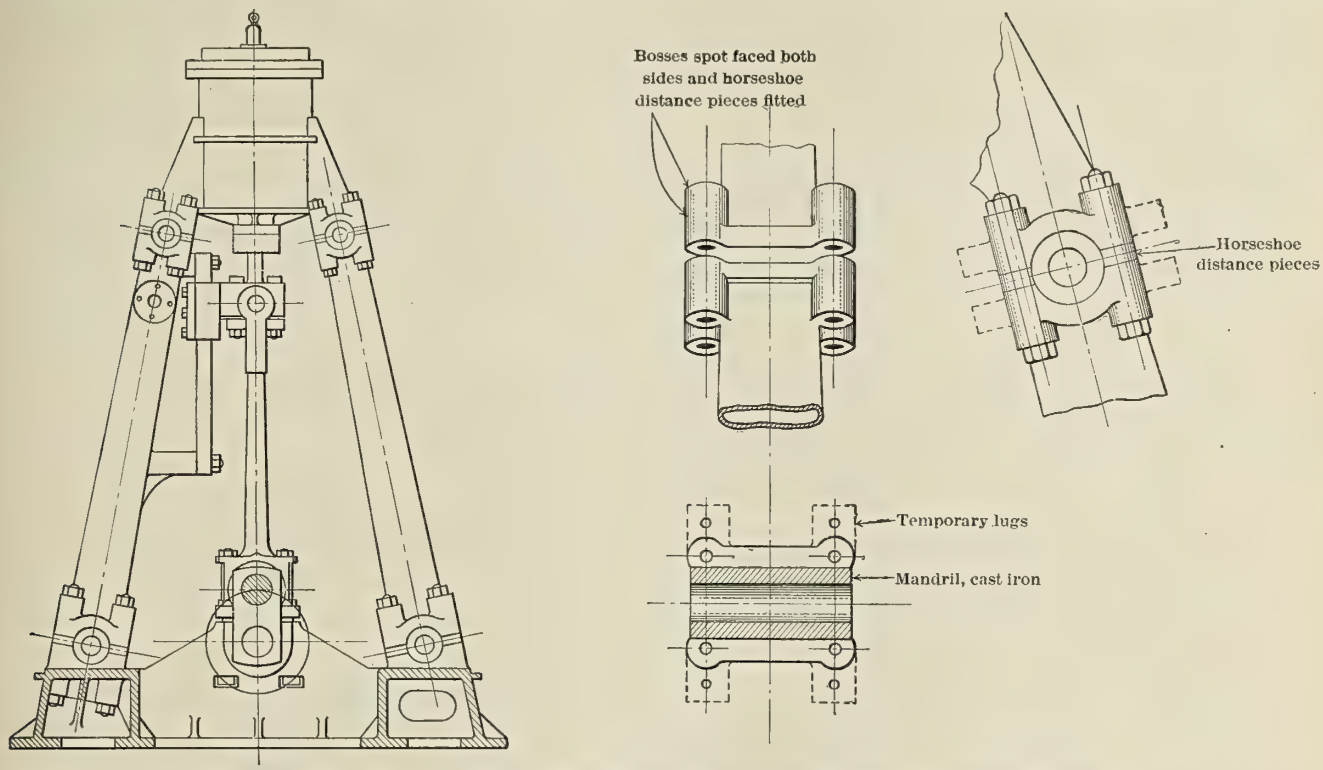
BY K. M. WALKER

ONE of the greatest handicaps that this country has had to deal with in meeting the present unprecedented demand for ships of all sizes and materials has been the difficulty experienced in obtaining main propelling machinery. In attempting to overcome this handicap, many and varied new methods have been devised to save labor, time and material in the construction of marine machinery and in the aggregate these new methods have resulted in a distinct saving all around, but even yet the demand far exceeds the supply.

If it were not for the fact that it has been generally considered necessary by engine builders to have large machine tools to handle and machine the heavy castings that form the bedplates, columns and cylinders of marine engines, a great many comparatively small shops without large machine tools would now be engaged in building this type of machinery.

It was this very condition that led to a new type of construction being evolved by a practical Pacific Coast engineer, in which the need for heavy machine tools is done away with.

The primary object of this method of construction is the ability to make a perfect metal-to-metal fit of the main portions of the engine to insure rigidity, a vital factor in marine engines, and a permanent alinement which cannot be disturbed, due to the fact that there are no undue stresses set up in the castings by pulling together faces which are not parallel.



Details of New Design of Framing for Marine Reciprocating Engine to Facilitate Erection

The time required in erecting the main portions of the engines would be reduced to a minimum, therefore the cost of this work would be substantially reduced, and as the larger machine shop tools are unnecessary for this purpose, the building of marine engines would come within the scope of the smaller shops, which hitherto have been unable to attempt it; their only limit, using this method, being their capacity to rig gear for lifting the parts into position.

The most necessary equipment would obviously be boring bars and heads, which are usually made right in the shop. In boring the column heads and feet for their respective mandrels, it is not necessary that the centerline be parallel with the centerline of the engine; this, then, allows of a little more leeway in any direction for a distorted casting. For holding up the bars, the ideal arrangement would be angle plates to take in all centers, or failing this, either concrete uprights with adjustment boxes or the mounting of bearing boxes and driving gear directly on the engine columns.

In erecting the engines, all the castings, cylinders, columns, and bedplates are bolted together with bolts and

wedges, the latter being for lining up preparatory to boring for the mandrels. The bore of the cylinders should be completely finished before erection.

After the engine is lined up, wedged by steel wedges driven between cylinder foot and column flanges, and bolted down solidly by bolts through the temporary lugs shown in the sketch the boring bar is inserted and all columns are bored out in line to a certain gage. A cylindrical cast iron mandrel is inserted in the bore when completed.

The column bolt holes are then drilled and reamed and spot faced as shown in the sketch. Small washerlike distance pieces are made to fit between the flanges, and when the mandrels are in place and flanges bolted down the small temporary lugs on the columns are chipped off. The heavy castings are then held rigidly in perfect alinement, with no undue strains set up which are liable to cause breaking.

In machining the sides for main journal boxes, gang cutters may be used, after the bottom is bored, being raised or lowered in the same way as a planer rail with bevel gears and screws. The machining of the facings for the reverse shaft brackets is done last and must be true with centerline of engine, and at the right height. The column facings for the reverse shaft brackets should be cast in true line horizontally with a hole cored through the center to take a boring bar, by means of which the facings are machined. By machining these brackets completely in the lathe, or boring mill, and leaving a small spigot to center them, they will be in alinement without further floor work, needing only to be raised to the correct height when the dowel pin holes are drilled. The thrust block, if designed to bolt against the bedplate, could be spigotted in the same way, and bolted into place without the usual lining up and fitting.

Again, in boring for the valve stem guide brackets, four of these brackets could be cast together, machined in the lathe with spigot parted, bolted into position, being in alinement at once. In fact, a large proportion of the machining could be done in this way, and a very great saving of time effected.

If the engine is designed to suit the tools at hand instead of designing it haphazard fashion, as is usually done, leaving the machine shop foreman to get over the difficulties as best he can, rather than throw away the casting, as often happens, very much time, labor and material could be saved.

New Lights on Economic Aspects in the Engineering Field

An evidence of the close relation which exists between the problems of business administration, employment and co-operative planning and production among competing industries, and the more technical work of the engineer was brought out by the selection of subjects handled in the papers read before the annual meeting of the Society of Mechanical Engineers, December 3 to 6, 1918.

Several years ago a wise man brought out the idea that the technical engineer with appreciation of the business and economic factors involved in government administration would make the most valuable public servant the country could employ. His ability as mayor of cities was taken as a point in question.

By extension of the same reasoning, the engineer should be best fitted for a position of chief executive in a large business undertaking. His prominence in war production has also demonstrated this. In fact, his insight into the alive facts of competent business management as evidenced by the following abstracts shows that he has come into his own.

Why has the word efficiency, which should stand for so much, fallen into disrepute in this country, is the question answered by H. L. Gantt, in his remarks before the society. We all recognize the importance of both individual and collective efficiency. Yet in the mind of the average business man or mechanic the term "efficiency engineer" raises a feeling of hostility. To some of us the reason seems plain, simply that we have in the past measured the "efficiency of our business" by the dollars acquired, rather than by the goods produced. In other words, the efficiency engineer has served the business system primarily in the accumulation rather than in the production of wealth.

A business system bent on the accumulation rather than on the production of wealth, which would even curtail the production of wealth if thereby a larger measure could be brought into its own coffers, must needs finally run to the limit of its tether. A method which makes more efficient such a system shortens the time which it has to run. An efficiency engineer who, consciously or unconsciously, served the business system in the exploitation of workmen, necessarily got the ill will of the workman. He later got the ill will of the business man, who found that the amount of wealth he could get by exploitation was strictly limited.

When the great war broke out in 1914 it became evident that the production of goods for the benefit of the community, and not the production of wealth for the benefit of those who control the industries, was the task which had been set the nations engaged. It took England more than a year to learn this lesson, and we should have been fully prepared for it in 1917. That we were not prepared for it, and that many believed we could still continue business as usual, is now history. We have learned, however, that production for the benefit of the community was the only basis on which we could carry the war to a successful conclusion. This has been emphasized by the elimination of "non-essential" industries.

There is another reason why the term efficiency has been brought into disrepute. In the past our cost-keeping methods have always loaded onto the part of the shop which produced the goods the total expense of the shop, including the part that was idle. The term "efficiency" then seemed to have no connection with capital or invest-

ment, but only with labor. Under such conditions there was but little inducement to the owner to make his machines produce more, and the reverse of an inducement to the workman, who was thereby laid off or saw his friend laid off. This fatal error which caused the opposition of the workman, and the lack of sympathy on the part of the employer, was evidently due to a false accounting system, which was devised to put all the burden of inefficiency on the workman.

When the great war started in 1914 it became impossible for the product turned out to bear the expense which had previously been distributed over a production three or four times as large; most people said, "These are extraordinary times; therefore we shall have to lay our cost system aside to keep till the war is over." Some people, however, realized that a system which is not good for an emergency, when it is most needed, has something radically wrong about it. This was the answer: The product of a factory must bear only the expense used to produce it. It cannot bear the expense of idle machinery which did not contribute to its production. The keener business men have realized that idle capital is no more entitled to wages than idle labor, and have begun seriously to study their plants to find out how they can use them to their full capacity. The result of this investigation is twofold:

(a) It does not result in laying off men, but gives employment to more men, which secures the good-will of the worker.

(b) It not only reduces the expense of maintaining machinery in idleness, but turns out a greater product from which revenue is gotten.

In a few words, then, if we will eliminate our false cost-keeping methods, and put in those that are correct, we shall not only benefit both employer and employee, but go a long way toward the democratization of industry.

Labor Dilution as a National Necessity

Not only in the field of efficiency has war acted as an educator. Its schooling is catholic. That the term "labor dilution" originated in England shortly after the declaration of war with Germany was brought out in a paper by Frederick A. Waldron. Its original application was intended to carry out in effect what the word "dilution" literally implied; namely, a thinning or spreading out. As applied to labor, it means the thinning out or spreading of the functions of the skilled workmen among those that are less skilled. A Bureau of Labor Dilution was therefore established by the Government to supervise and carry out its requirements.

The original objective of this bureau was to relieve the skilled workman in the performance of certain elementary functions of a task by employing less skilled workers for this purpose and thereby accomplishing a given task in a shorter time. This bureau has created an element in labor dilution which was not included in the original programme in that it has already established in the minds of the consumer the fact that waste of labor and materials is the greatest foe to labor dilution. It is the engineer who must solve this problem in a scientific and satisfactory manner.

Ultimately it must be "the survival of the fittest." A nation's industries must be those for which it is particularly adapted; they must be conducted in the most economical manner, and facilities for vending and transporting their products must be on an equally economical basis. For products of equal quality, those having the lowest unit costs will naturally maintain commercial and industrial supremacy. The nation, therefore, which can deliver to the consumer its converted natural resources in the minimum time with the least expenditure of human energy is the nation which will lead the industry and commerce of the world.

This will involve the engineering of men and materials in the broadest sense. To accomplish this means a most broad and comprehensive national policy in the organization of our legislative, banking, business, agricultural, transportation, mining and manufacturing policies.

Labor dilution, as a part of the reorganization problem, should include the questions of the functionalizing of the work of the skilled operative for the less skilled operative, the eliminating of all work except that which is absolutely necessary to produce the results, and the economizing in the use of the necessities of the day.

After discussing the post-war problem of the scarcity of unskilled labor, due to cessation of immigration and the return of so many foreigners to Europe in war service and for reconstruction work over there, Mr. Waldron held that standardization of products and processes, aided (1) by co-operation of legislators, engineers, capital and labor, (2) by elimination of non-essential effort for compiling statistics, office and administrative work and of the non-essential citizen—the idle man—and (3) by education of executives and workmen so that the *fullest use of all the available man power would be possible*—all these factors would bring about results in this reconstruction period.

A study of the problem indicates that, in its broadest meaning, labor dilution and the engineering of men are practically synonymous, since the former involves all that the latter implies.

British Engineering Standard Association

The subject of standardization was very ably handled by C. Le Maistre, secretary of the British Engineering Standards Association. It may fairly be said that the primary objects of standardization are to secure interchangeability of parts, to cheapen manufacture by eliminating the waste of time and material entailed in producing a multiplicity of designs for one and the same purpose, and also to expedite delivery and so reduce maintenance charges and stores. In 1901 the British Engineering Standards Committee was founded. From the small nucleus of seven members, a far-reaching organization has developed with some 160 committees, sub-committees and panels, including in all over 900 members, and dealing under one central authority with standards relating to practically the whole field of engineering. The British Engineering Standards Association has provided the neutral ground upon which the producer and the consumer, including the technical officers of the large spending departments of the Government and the great classification societies have met and considered this subject of such vital interest to the well-being of the engineering industry of the country.

The standardization of steel sectional material was the first work taken up by the committee. The British standards for this material, so important in the construction of ships, bridges and underframes for railway wagons, have had a very wide adoption. The total number of sections is some 175, and the recently formed Mercantile Section of the Admiralty, as a war measure, was able to select from this list a largely reduced number and so put into operation an exceedingly economical measure with but little delay. The testing requirements of Lloyd's Register and the other great classification societies and the Board of Trade have been unified through the work of the committee.

It would appear from the steelmakers' returns for 1913,

giving the tonnage of lengths rolled of each section, that 95.7 percent had been produced by standard rolls, and only 4.3 percent by non-standard rolls, the work thus having proved of immense utility to the steel makers.

In regard to the question of finance, the funds for carrying out the work of the committee have been provided by the Government and the industries concerned. In 1903 the Government included in the estimates a substantial contribution, which was subsequently extended for the years 1904-5-6 by a grant-in-aid equal to the amount contributed by the supporting institutions, manufacturers and others. This was continued on a smaller scale down to 1916, and a further grant on the same condition is being continued to March, 1919. The Indian Government has been a generous supporter of the committee, and the governments of other overseas dominions have also given financial assistance.

Members of the Governing Committee

The Main Committee, as the governing committee is called, consists of members nominated by the leading technical institutions, viz., the Institutions of Civil Engineers, Mechanical Engineers, the Iron and Steel Institute, the Naval Architects, and the Institution of Electrical Engineers; there are also two representatives of the Federation of British Industries; and three members, not representative of any institution or association, but elected for their eminence in the profession.

The Main Committee is the sole executive authority, and all specifications and reports are presented to it for final adoption. The procedure before embarking on any new subject is to ascertain by means of a representative conference that there is a volume of opinion favorable to the work being undertaken. If such is the case, the Main Committee nominates the chairman of a sectional committee to take up the work in question, this committee being formed of technical officers, representatives of the various Government departments interested, representatives of the trade organizations concerned, and, lastly, experts in the subject to be dealt with.

The most recent addition to the association's activities is that of the standardization of the details in the construction of ships and their machinery. A conference recently convened at the instance of the Board of Trade, and representing Government departments, shipowners, shipbuilders and engineers, classification societies and consulting and naval architects, has unanimously decided to recommend to the Main Committee the setting up of a complete section to deal with this branch of engineering, in which, in common with all others, economic production, fostered by interchangeability of detailed parts, is of such vital importance.

Standardization, after all, is no more and no less than proper co-ordination. To effect it may necessitate the sinking of much personal opinion, but, if its goal, through wideness of outlook and unity of thought and action, is the benefit of the community as a whole, standardization as a co-ordinated endeavor is bound increasingly to benefit humanity at large.

Employment of Labor at Hog Island

America's most colossal experiment in standardization of product is exemplified by the fabrication of standard ships at Hog Island, hence the details of the employment of labor there as presented by Dudley R. Kennedy are very closely related to the problems of efficiency, labor dilution and standardization already discussed.

In the inception of the job when the engineering estimates were in preparation, it was recognized that the labor problem would be one of the cardinal difficulties of the undertaking. Notwithstanding the difficulties, there were upon the payroll on January 19, 1918, 26,700 men, and there are now 35,000 employees. To obtain this number and maintain the necessary interim quota it has been necessary to hire a few more than 230,000 people in a calendar year. This means a labor turnover of nearly 700 percent.

The management, appreciating the size of the human engineering phase, organized a department styled the Industrial Relations Department, having jurisdiction over the branches, Employment, Medicine, Surgery, Sanitation, Safety, Housing, Feeding, General Welfare and Service and Compensation.

The manager of Industrial Relations ranks, with equal authority, with six other heads of departments, reporting direct to the president. This is an important point, as many companies now appreciate the importance of the human machine to a degree which places an executive in charge of Industrial Relations with authority paralleling that of executives in charge of other major phases of administration. This department occupies a two-story building 251 feet long by 48 feet wide, with an ell 132 feet long by 63 feet wide. The employment department occupies the bulk of the first floor. The building was planned to afford as nearly a stream line or continuous process as possible through the various stages of the necessary employment routine. Immediately the applicant for employment finds for himself a place in one of six lines, formed before six doors, over each of which appears the name of the positions or jobs for which men are being examined in that "interviewing room." There, a man familiar with the specifications of the job for which he is selecting applicants gives a short, courteous, but adequate and firm catechising, and determines the applicant's fitness for the position which he seeks.

Progress of the Applicant Through the Yard

Having accepted the applicant, he passes him on to the registration clerks, who fill out a registration blank covering the many details which it is necessary to record for purposes of identification, for the State Workmen's Compensation Law, for the Selective Draft and for statistical purposes. This form, when completed, is handed the man and he proceeds to the physical examination, where he enters one of thirty booths and receives an examination in the nude to determine his fitness for work and for the particular job to which he is assigned.

Successfully passing this examination, the applicant proceeds to the photographic room, where he is photographed *with* his sequential employment number, which becomes his identification and payroll number, and shows his height and weight and date of hiring.

The new man is then taken to the dispatcher and there the new men are grouped and taken by one of fifteen messengers to the portion of the work for which they have been hired. When the messenger delivers a new employee to a department, the requisition issued the day previous is canceled, and the foreman signs a receipt discharging the obligation of the Employment Department.

The messenger is made necessary for several reasons, but principally because the plant covers 900 acres, has 18 miles of streets and is 2½ miles long and a mile wide, and it is quite a task for a newcomer to find his way about.

Hog Island has all the problems of sanitation and hygiene of any city of 35,000. The mosquito has been absolutely eradicated, and with it vermin of all kinds. The department maintains a chemical and bacteriological laboratory, which tests the drinking water supply at all points

of egress daily, analyzes sewerage, samples and tests all food served, and does all the work of the hospital on sputum, pus, excretions, blood, urine, etc. It also maintains the medical dispensary, contagious hospital and detention barracks, and its alertness and efficiency have made possible the phenomenal record of last winter as to the general health of workers, resident on the island, and the record of the present influenza epidemic. For both, Hog Island records were as good as any shown by army cantonments.

The housing department task has been trying, but barracks have been completed on the island for 5,000 employees, a bachelor hotel has just been opened accommodating 2,200 men, with 2,200 rooms. A unit of 953 homes for married employees of Hog Island, which rent for an average monthly rental of $25 for six rooms and bath, is being completed. During the last year the housing department has furnished 16,500 accommodations in the city of Philadelphia.

The wage setting and adjustment for the job has been a serious task, and, while the U. S. Shipping Board Labor Adjustment Board has fixed a standard scale for all shipyards, covering the shipbuilding trades, the construction of Hog Island presented many problems on construction rates involving almost every conceivable craft. Not one day has been lost through strike or labor difficulty. The "open shop" has been maintained throughout, and it is only justice to say here that organized labor has, in the main, lived up to its agreement with the Government in not attempting to force recognition or the "closed" shop.

Almost the universal problem with employers has been the question of securing a sufficient number of employees to operate at maximum capacity. It has been a question of "collection," not of "selection."

NON-FINANCIAL INCENTIVES

As we begin to deal more and more with large organizations like Hog Island, and as operations become more highly specialized daily, the new theories of dilution of labor and standardization of parts tend to make these operations more stereotyped. How can we still retain the old feeling of craftsmanship is the question which Robert B. Wolf endeavors to answer in his paper on non-financial incentives. By the rivet records kept in the shipyards, this scheme has been attempted; the experiment, however, tended toward the development of expert technique by a few rather than complete understanding of all the features involved in the operation by the many.

Mr. Wolf believes that creative work can be done to a great extent in modern industry without radical changes in equipment. To do this, individual progress records are necessary, so that the workman can know from day to day how he is improving in the mastery of the process.

Although the example taken from the wood pulp industry, with which the author is connected, has no direct application in many trades, the principles involved might be applicable elsewhere.

The example, illustrated by Fig. 1, is from that branch of the wood pulp industry known as the sulphite process and shows a cooking chart which was designed to give the cook information about the reactions in the digesters in which the wood chips are cooked in a 6 percent solution of sulphurous acid partly combined with a lime base. The skill in cooking consists in the proper control of the relief valve.

At the end of the cooking process the gage and steam pressures will naturally come very close together, as the greater part of the SO_2 gas has been used. The gas-pressure curve is obtained by subtracting the steam pressure from the gage pressure. It is really a resultant of the other two. If it drops too rapidly the cook knows he is relieving his digester too hard and checks the opening of the relief valve. If it does not drop rapidly enough he knows he must open the valve wider in order to increase the relief. Naturally, an ideal cooking chart was soon formed, being the joint work of the cooks handling the digesters and of the chemical research department.

Immediately after the introduction of these charts a very marked increase in the uniformity of the pulp was noticed, and the cooks, while at first opposed to the new method of "cooking with a lead pencil," as they called it, soon learned to like their work much better, for the reason that they now had some way of visualizing the work in its entirety. In addition to more uniform quality of the pulp,

HOURS	TEMP	GAGE PRESSURE	STEAM PRESSURE	GAS PRESSURE	NAMES OF COOKS AND GENERAL INFORMATION FILLED IN HERE.
0		0			
1		20			
2		48			
3	212	75	0	75	
4	222	75	3	72	
5	233	75	7	68	ACID TEST { Total 7.00
6	240	75	10	65	Free 6.05
7	250	75	15	60	Combined 0.95
8	259	75	20	55	
9	273	75	29	46	
10	288	75	41	34	Acid Temperature 75 Degrees Fahrenheit.
11	284	57	38	19	
12	281	40	35	5	
13					

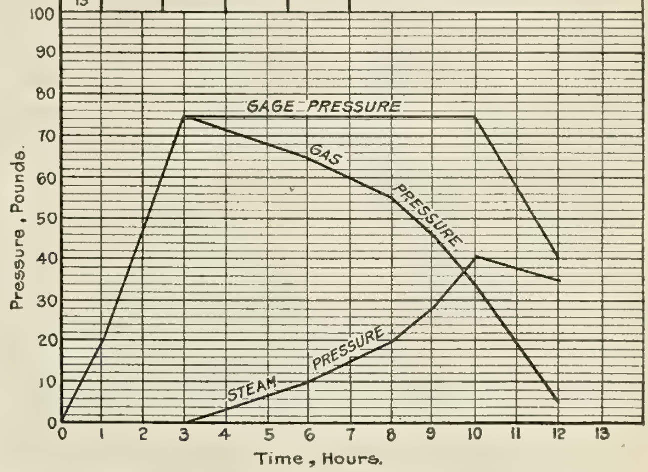


Fig. 1.—Cooking Chart for Wood Pulp Showing Steam and Gage Pressures and Gas Pressure Computed from Them

the yield from a cord of wood increased something over 5 per cent. It was found necessary to establish a continuous progress record to stimulate constant effort.

Such records can be grouped under three main headings: Quantity records, quality records and economy or cost records. Records of the costs will be a natural growth of the interest developed, as will intelligent study of new equipment.

We should never lose sight of the fact that the degree of conscious self-expression which the workman can attain is in direct proportion to the ability of the organization to measure, for his benefit, the impress of his personality upon it.

"In conclusion," said Mr. Wolf, "I am well aware that to some of you this may seem like pure philosophical speculation far removed from the practical affairs of everyday life. I have said nothing, however, that I cannot back up by any number of additional illustrations, and my hope is that the example given will stimulate others to make similar investigations, so that we can fulfill our mission in this country by evolving an industrial philosophy which will have for its ultimate aim the continuous unfoldment of the latent powers in man."

Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliares—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Two Handy Tools for Repair Work

The two handy tools illustrated have been found to be time and money savers in the installation or repair of power plant machinery.

In Fig. 1 is shown a ratchet drill holder. This sketch shows plainly just how the holder is made; also the advantage over the old-style holder or, as it is generally termed, the "old man." For drilling pipes or shafting especially this holder will prove a time saver.

The two elevator rods consist of 7/8-inch by 24-inch or 36-inch round C. R. M. steel, bent as shown for an 8-inch or 12-inch radius and threaded for a length of 14 inches. The clamp iron and bridge are 12 inches by 2 inches by 5/8 inch, respectively. Drilled with a 15/16-inch drill on each end to slide over elevating rods, the clamp iron has an opening in the center for the drill guide, as shown in sketch.

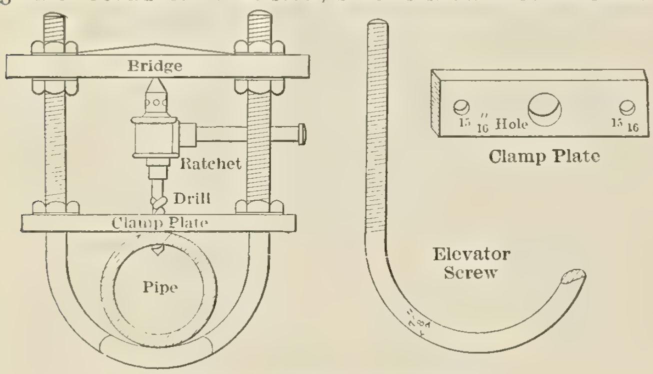


Fig. 1.—Ratchet Drill Holder

In Fig. 2 is shown a shaft and pump piston rod straightener. This tool will come in handy for many pump, shaft, or piston rod repair jobs and should be employed in any shop doing engine repair work and on board ship.

The construction of this tool is very simple and can easily be made in any blacksmith shop; that is, the part marked *B*, the dimensions of which are given. The arm or lever plate has a length of 12 inches, 18 inches, 24 inches, or longer, according to requirements. The fulcrum or shaft-bending screw is of heavy construction, made of carbon steel and hardened on the point, having a full length of V thread, five threads per inch. A "bending indicator" is attached to *B*, thus eliminating all guesswork when bending shafts.

When there is no lathe at hand for doing this work, a work bench or the floor may be used as a base for revolving the shaft or rod by using two 3/4-inch by 10-inch bolts, cutting off the heads, bending the bolts to an L, then cutting a 60-degree bevel on the end and driving the bolts in the bench or floor.

Stillwater, Minn. Andrew Dorthen.

A Feed Water Improvement

Some time ago there occurred in the columns of Marine Engineering a general discussion concerning the best position on the boiler for the feed check valve. Judging from the troublesome experiences of my sea-going brothers, as well as my own, this problem of feed water heating is, in my opinion, entitled to far more consideration at the hands of superintendent engineers than it generally receives.

In this particular case the feed water caused so much trouble that our chief resolved to make some improvements. This we were all glad to hear, for the saving in coal and labor, not to mention the improved circulation of the water, more than compensated for the additional expense.

I can safely recommend the idea evolved from the following repair to all my brother engineers, since our superintendent was so well pleased with the results obtained that several other vessels of the company's fleet were so fitted.

The old check valve with its internal feed pipe, which projected into the interior of the boiler for about 3 feet, was taken off and a new check valve fitted on, but, instead of the internal pipe having slots on the under side to allow the feed gaining access to the boiler, it was screwed at the end (gas thread) so as to engage a coupling. A straight length pipe, about 4 feet long, threaded at both ends, was then screwed into the coupling at one end, and at the other end an elbow branch was screwed on; then another straight length of pipe, threaded at both ends, was fitted, one end being screwed into the above-mentioned elbow branch. This last length of piping measured the length of the boiler.

A second elbow branch was then screwed to this straight length of pipe, and a straight length of pipe, about 2 feet long, was coupled onto the last elbow branch. While the other end was screwed into an elbow piece, a length of

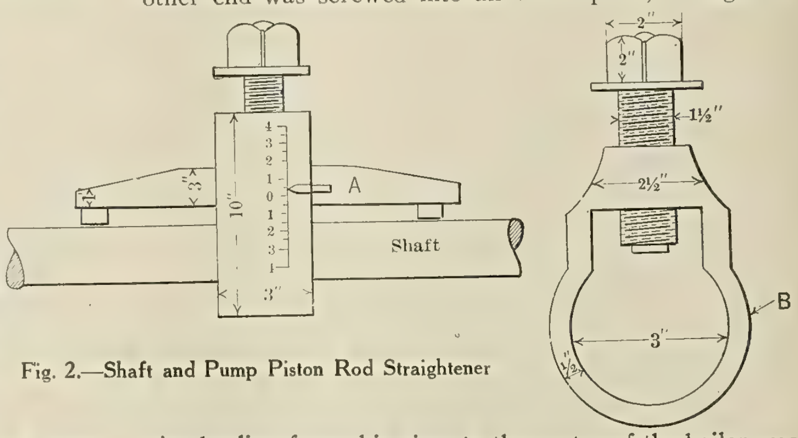


Fig. 2.—Shaft and Pump Piston Rod Straightener

pipe leading from this piece to the center of the boiler was next laid down, and to this length a T piece was coupled, which allowed the feed water to gain admittance to the boiler. This T piece was made 3 feet 6 inches long and reached down fully 18 inches, all the pipes and elbow branches being jointed by touches of red lead and screwed well home.

It will be readily understood that all these feed pipes were laid down on the top of the tubes which carry heat

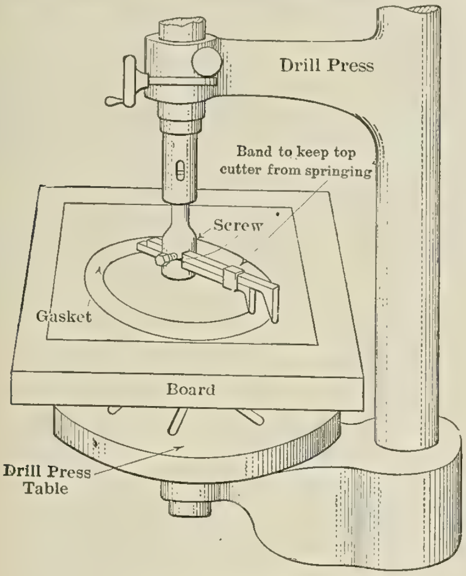
to the water, so that the feed water was practically obtaining heat from the tubes beneath and from the boiler water above.

No doubt many of the readers will wonder why bends were not employed instead of elbow branches. This was done in order to allow for easy inspection of the different straight lengths in case any trouble should occur.

Sydney, N. S. W. ANDREW LANG.

Gasket or Circle Cutter

A very handy gasket or circle cutter for use in the spindle of the drill press is made by machining a piece of 2-inch round stock to a standard Morse taper to fit the



Gasket or Circle Cutter

drill press, drilling and filing a slot for the cutter bars and fitting two securing cap screws. The cutter bars are each adjustable to various diameters. The sketch tells the story. C. H. WILLEY.

A Steam Pipe Repair Job

While in port the chief engineer decided to have a few necessary repairs made to the engines and boilers. Accordingly, orders were given to blow down all boilers, and, having raised steam on the donkey boiler, the second engineer went up on top to open the auxiliary stop valve. Immediately on opening it, however, he was surprised to hear a hissing sound. Upon investigation, a piece of pipe, as

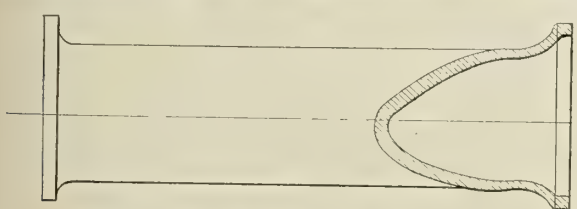


Fig. 1.—Steam Pipe as Blown Out

shown in Fig. 1, was found to be blown out. This, of course, made it necessary to close down again and generate steam in one of the main boilers.

The chief, in the meantime, went ashore to see what he could pick up in the way of piping. His search resulted in a piece just 30 inches too short, so it was decided to make the following repair:

By referring to Fig. 1, it will be seen that the blow-out occurred in such a manner that the pipe had the appearance of having been cut by a knife, the break being almost at an angle of 45 degrees. This, however, enabled us to make a good repair job.

By removing the lengths of pipe connected to the fractured piece, we were able to drill two 1 1/16-inch holes through the broken pipe and two holes of the same size through the bottom part of the steam pipe. We then made two 1-inch studs with nuts and washers, also two pairs of clips, or brackets, Fig. 2.

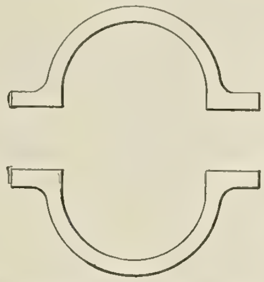


Fig. 2.—Improvised Brackets

The broken part of the pipe contained two bolt holes; but we did not think it wise to place bolts through, so the holes were drilled and tapped for ⅞-inch studs, since it was evident that on being tightened the studs would not draw the fracture apart, as would be the case if bolts were used.

Everything being now prepared, a large quantity of Smooth-On, previously made up, was applied to the fractured pipe, and, carefully putting on the broken part, so as not to disturb the Smooth-On, we had it properly bolted

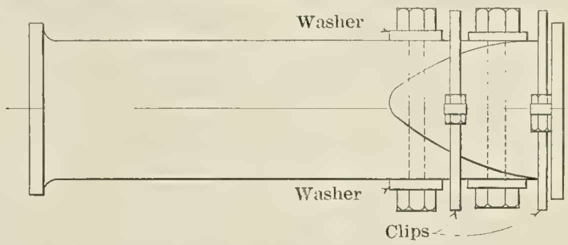


Fig. 3.—Pipe Showing How Repair Was Effected

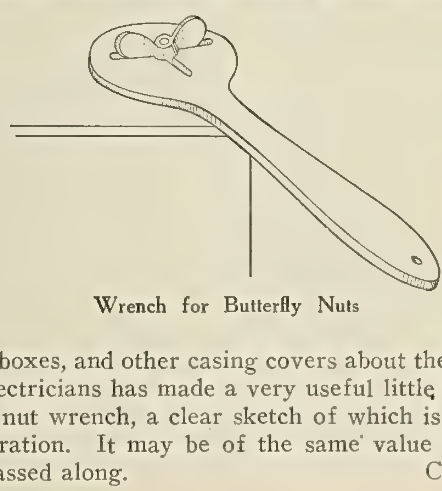
down with the studs and washers with a lappet or gromet thoroughly steeped in Smooth-On. After adjusting the studs we then put on the clips, one between the flange and die stud and the other between the two studs. The remaining length of pipe was then bolted on and the job was completed. Steam was again raised in the donkey boiler, and, heating up slowly, we put a little more strain on the studs, clips and joint. After lagging the pipe over again, the stop valve was fully opened and we were delighted to see that our efforts were successful.

Fig. 3 shows how the repair was effected.

MECHANIC.

Butterfly Wrench

For readily unscrewing and tightening of the butterfly nuts of the various electrical circuit breaker panel doors,



Wrench for Butterfly Nuts

junction boxes, and other casing covers about the ship, one of our electricians has made a very useful little plate iron butterfly nut wrench, a clear sketch of which is shown in the illustration. It may be of the same value to others, so it is passed along. C. H. W.

Some Interesting Repairs

The following may be of interest to some of the "sea-going" readers:

Fig. 1 represents the high pressure column and part of the condenser of a triple-expansion engine, column and condenser being cast in one. While under way, water commenced to run down the high pressure guide, and after a short while a piece of the guide, about 8 inches by 10 inches, fell out of the column at *A*. Even with the engine stopped the water continued running, and for a time we were at a loss to understand the cause.

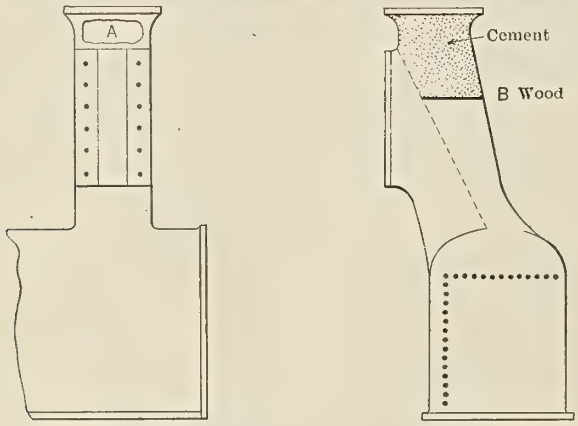


Fig. 1.—Showing High-Pressure Column and Part of Condenser of Triple-Expansion Engine

On shutting the main injection, the flow stopped, and after opening the condenser door we found that the column was divided so as to form an air vessel for the circulating water. A wrought iron patch, fitted temporarily over the hole and secured by ⅝-inch brass tap bolts and a rubber gasket, took us into port; but, as the metal was spongy and did not give a good hold for the screws, these were removed later and a piece of wood fitted at *B*. The column above the wood was then filled solid with Portland cement, thus making a permanent repair.

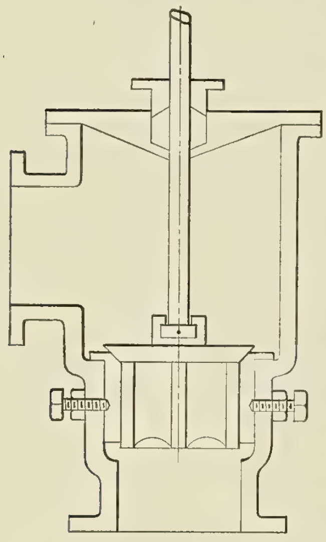


Fig. 2.—Showing Stop Valve on the Same Engine

Fig. 2 shows the stop valve (8 inches diameter) on the same engine. While giving the engines a try-out, the seat lifted, entirely shutting off the steam. As the valve was only partly open, we were able to get the seat back by closing the valve tightly. This was repaired by drilling and tapping four ¾-inch holes, just allowing the point of the drill to enter the brass seat. Tight-fitting tap bolts were screwed home and lock nuts set up, after which the seat gave no trouble.

Fig. 3 shows a diagram of the working parts of a steam reversing gear (engine 1,200 indicated horsepower). This gear had given trouble for years; the steam cylinder received steam at 160 pounds per square inch, but, in addition, one and sometimes two men were required to help pull around the wheel. In port, with no steam available, the gear could be operated easily by the handwheel, but on applying the steam the gear locked itself. After some discussion we finally came to the conclusion that the fault lay in the screw on the shaft. As this had a rather fine pitch, the force of steam, acting almost at right angles to the thread, produced a locking action. The shaft was therefore cut and a new end fitted having a thread of double the pitch and new nut to suit.

After this the gear gave no further trouble; in fact, it was as handy as an all-round gear and quicker in action, although, of course, somewhat harder to move when tried by hand alone.

San Francisco. A. B. BLUNDUN.

Some Defects in Marine Design

The need for improvement in the design and layout of engine and boiler rooms, especially in auxiliary plants—pumps, fans and electric lighting—is evident to the most casual observer. Those who work in the engine room, however, also realize certain defects in the design of boiler mountings, such as check valves, stop valves, safety valves and steam pipes. It is against these that I wish to vent my sentiments.

Now take, for instance, the check valve, which, in my estimation, is one of the most important valves on a boiler.

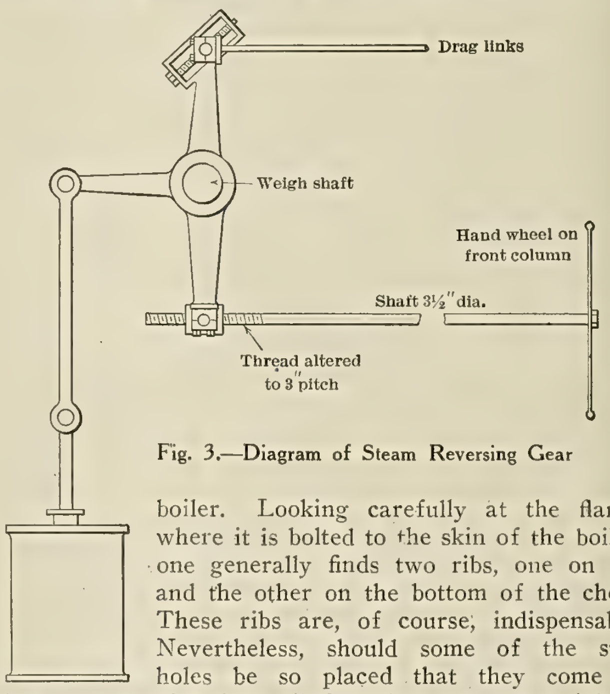


Fig. 3.—Diagram of Steam Reversing Gear

Looking carefully at the flange where it is bolted to the skin of the boiler, one generally finds two ribs, one on top and the other on the bottom of the chest. These ribs are, of course, indispensable. Nevertheless, should some of the stud holes be so placed that they come in close contact with these ribs? When one gets a job of taking off a check valve and putting it on again one is apt to wish the draftsman who designed the job the compliments of the season, as I have done many a time. I refer principally to tightening up those nuts which foul the ribs. Since in these positions it is impossible to grip a full nut with the spanner, one generally has to use a calking tool to tighten up these nuts. You can never judge whether the nuts are hard up by this method, and as a result the nuts are chewed away. That makes it always harder for one when the valve has to come off again.

But this is not the only disadvantage. By using a calking tool, the studs are very liable to be broken off, which generally means taking off the valve and starting all over again. In the case of other nuts the holes in the casting are generally marked off and drilled so close to the body of the casting that when the nuts are being tightened down the corners of the nuts generally foul the body of the casting. This results in one's having to take two bites at the nuts instead of one.

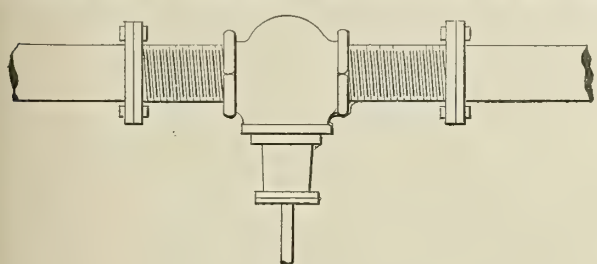
In the case of the stop valves, the bridge is often cast onto the cover. One generally finds four nuts, two on each side of the bridge, hard up against the bridge. The position of the stop valve on the boiler, of course, brings it more directly under the control of the engineer. Not so with the check valve. One generally finds trouble in gaining access to this, because the smokebox is hard up against it. This inconvenience makes the nuts which are close to the ribs still harder to tighten up.

But one of the most badly designed jobs I have ever seen or handled was in a stokehold containing six boilers, where an auxiliary steam pipe was laid down, and also a line of main steam piping. Both lines of piping commenced on the forward center boiler and ran parallel across the top of the center after boiler to the engine room. On the top of this boiler was a main stop valve, and just where the main steam pipe passed this stop valve there was an expansion joint with six 1⅛-inch nuts on the gland. The distance from the expansion stud to the stop valve was only 3 inches, with the same distance between the auxiliary steam pipe and the other expansion stud. The spanner could only be used on the two top nuts. To slacken or tighten up the other four nuts one had to employ the services of a light flogging hammer and a chisel bar, which generally resulted in knocking the nuts totally out of shape and making them useless. Every time this expansion joint had to be packed it meant new nuts; and yet marine engineers are constantly being told to economize! I had the pleasure of packing this particular joint twice, with the temperature well up over 90 degrees—the hardest job experienced during my sea time. In my estimation, it would have been far better to have designed this gland to carry four 1¼-inch nuts instead of six 1⅛-inch nuts. An expansion bend would have obviated the trouble and saved time, money and unsuitable language.

A. L.

Facilitating Removal of Regulating Valve

On the supply or make-up water lines to our feed tanks we had a number of balanced float-controlled regulating valves, and because of the wire drawing of the water it was found necessary to remove them and grind them in at frequent intervals. These were 2-inch lines, and the regulating valves were of the screwed type, so that their



Removable Regulating Valve

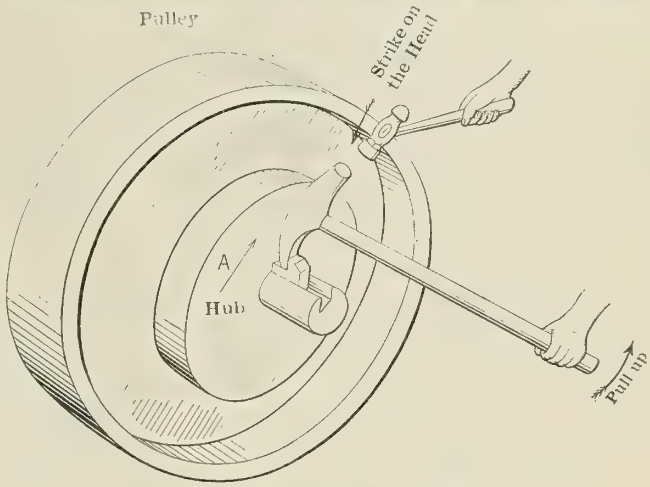
removal involved the taking down of part of the make-up piping each time.

We finally overcame this difficulty in the manner shown in the sketch. Two long nipples were screwed in the inlet and outlet of the valve, and then to the end of each nipple was screwed a companion flange which matched a similar flange screwed onto the ends of the water piping. The distance between the flange faces was made a standard dimension—10 inches. Hence when it was necessary to regrind a valve it could be quickly removed from the line by simply removing the holding bolts from the flanges and slipping out the section containing the valve. An extra valve, made up with the nipples and flanges, was always kept on hand, which could be slipped into the space and the whole controlling mechanism put back in operation in less than ten minutes' time. The worn valve could then be ground in at leisure and held in reserve.

W. A. L.

Key Jimmy

This tool is about the handiest and most efficient simple tool that the writer has ever met with, and because it is so constructed like a jimmy it has been given that name.



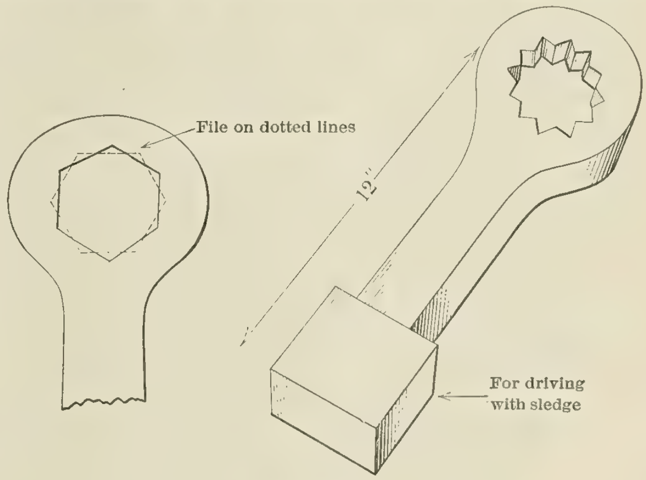
Key Puller Which Does the Work

Its effectiveness lies in the combination of leverage, plus jarring forcing blows, as illustrated. The upward pull of the lever is maintained while striking the blows as the key moves out. Packing pieces are used behind the heel of the tool at *A*.

Engineer.

Star Wrench

While the writer is not the originator of this type of wrench, he has used several of them on board ship for adjusting main bearing nuts, and, as they permit the wrench being used so handily at most any angle, I have



Star Wrench

often wondered why all ships' engine rooms do not have them.

I have visited many ships and have noted that the old type hexagon box wrench is about the only thing they have, so I am submitting these sketches showing how the old wrenches can be made over into this handy star type.

Old Timer.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

CONDUCTED BY "NAVAL ARCHITECT"

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

There will appear in this column from time to time questions which have been asked by the Board of Steamboat Inspectors in the various examinations for engineers' licenses conducted by them. Such questions will be denoted by an asterisk (*) placed before the number if from examination for grade of chief, and by a dagger (†) if from examination for other grades.

Development of Hawse Pipe

Q. (991).—Will you kindly explain how to lay out and develop hawse pipes for stockless anchors, also how to obtain a true section through the centerline of same with respect to pipes and shell of ship?

A. (991).—This question would require a rather lengthy answer, and it does not seem well at this time to publish the same in these columns. One method of making this development is given in "Laying Off," by Attwood and Cooper, published by Longmans, Green Company, New York.

"Push" and "Pull" on Crank Pin

Q. (994).—Find push and pull on a crank pin, 72-inch cylinder, 10 pounds pressure, 26-inch vacuum. Should the text not read "push" *or* "pull"? What would you give as the definition of "push" and of "pull"?

A. (994).—This question was answered in the July, 1918, issue. It is probably expected that the answer gives the steam force acting upon the piston rod at the beginning of the down stroke and up stroke, or a "push" in one case and a "pull" in the other.

Duties of Loftsman, Shipwright and Shipfitter

Q. (990).—Please define the duties of a loftsman, shipwright and shipfitter. X.

A. (990).—Loftsman is the term given to men who, working indoors, prepare in the mold loft templates of the various parts of a vessel's hull. It is customary in this country for the loftsman to take the offsets from the draftsmen's small scale lines, lay them down and fair them full size on the loft floor. From blue prints he may then proceed to make molds of the frames, floor plates, deck beams and practically all parts of the vessel—in many cases all but several of the shell plates. The templates are usually made of wood or heavy paper.

To the shipwright or ship carpenter is given the work of laying the keel blocking, putting necessary staging in place, shoring the structure and fairing the frames with ribbands. Placing the launching ways, laying planking, tank-top ceiling and all outside carpentry work would generally be done by the shipwright. The fact that a loftsman often used wood in the construction of the molds made it natural for the shipwright to take up loft work. Mocking up intricate portions of the structure does in reality require no small skill.

Formerly a shipfitter was expected to make all molds, using blue prints then issued and constructing molds of the work as these were necessary. Now the shipfitter lays off the plates and shapes from the molds sent from the loft, directs the assembling of the structure and lays off holes not located in the loft. He may be given the work of making molds in case of alteration of difficult plates, which is termed "lifting."

The truth of the matter is that all three of these trades are similar; in fact, in large shipyards each of them in turn is often divided into several special ones.

Point of Cut-Off

Q. (993).—An engine has 3 feet 6 inches stroke, ⅛-inch lead and 2½-inch lap; the valve travel is 10 inches. What is the point of cut-off? I would appreciate having the answer in the form of a formula and also by a graphical method.

A. (993).—Fig. 1 shows the solution of the problem by Zeuner's diagram. With O as center and OG radius, equal to one-half the valve travel, draw circle ECG. Lay off OA

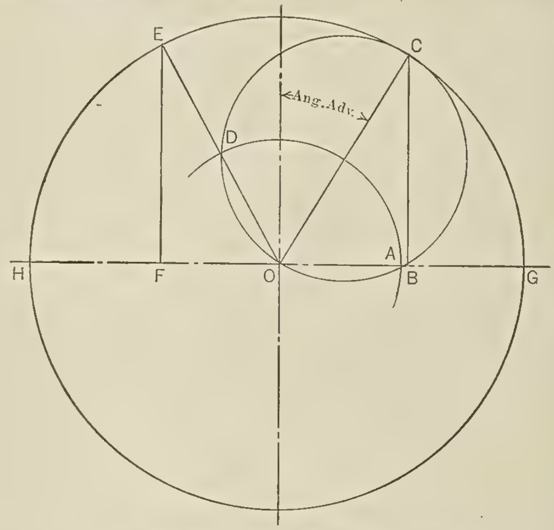


Fig. 1.—Solution by Zenner's Diagram

equal to the lap and AB equal to the lead, and erect BC perpendicular to OG. The line OC will now be the diameter of the circle BCD, which in turn will give the location of the valve from its mid position. Hence the cut-off will occur when the valve displacement is equal to the steam lap, or at the crank angle ODE. If the effect of the connecting rod is neglected, cut-off will occur at $\frac{GF}{GH}$, or about .74 of the stroke. Although possibly there are some arbitrary rules which will give the position of the cut-off, I do not know of these. If desired, the point of cut-off may be found by this formula, which requires a knowledge of trigonometry for its application:

$$\tfrac{1}{2} \sin \left[\cos^{-1}\left(\frac{\text{lap}}{\tfrac{1}{2}\text{ travel}}\right) - \sin^{-1}\left(\frac{\text{lap} + \text{lead}}{\tfrac{1}{2}\text{ travel}}\right)\right] + .5$$

This formula, likewise, does not take into account the angularity of the connecting rod.

Effect of Linking Up High-Pressure Cylinder

Q. (992).—Suppose you have an engine whose cylinders are developing the same power and you run the cut-off in on the high pressure, which cylinder does the most work?

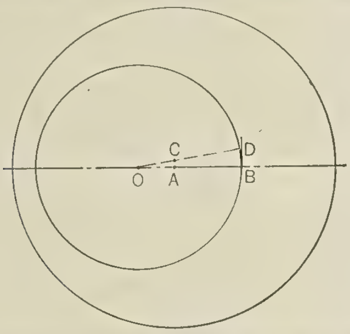
A. (992).—Running the cut-off in on high pressure will reduce the total work of the engine; it should not change the division of work among the cylinders.

Valve Movement by Shifting Eccentric

Q. (995).—If you move an eccentric having a 5-inch throw, ⅛ inch on the shaft, diameter 15 inches, how much do you move the valve? How would you measure the ⅛ inch on the shaft? The answer is ⅛ × 5/15 = 1/24 inch. How would you reason this out?

A. (995).—For small changes of angular advance (shift of eccentric) the change in position of valve may be readily found in the manner outlined here.

O is the center of shaft, *A* the center of eccentric. Then if the eccentric is moved around the shaft so that *B* takes the position *D*, then *A*, the center of the eccentric,



will move a proportionate distance and will be at *C*, or

$$\frac{AC}{BD} = \frac{\tfrac{1}{2} \text{ travel of valve}}{\tfrac{1}{2} \text{ diameter of shaft}}; \text{ i.e., } AC = \tfrac{1}{8} \times \frac{2\tfrac{1}{2}}{7\tfrac{1}{2}} = 1/24 \text{ inch.}$$

It should be noted here that the throw of the eccentric, as used in this case, means the total travel of valve.

Women as Naval Architects

The entrance of women into many scientific activities has shown itself from time to time in an earnest desire to be given a status in the particular activity in which they have qualified themselves to become useful members. It is certainly a sign of the times when the council of the Institution of Naval Architects is seeking to obtain the views of the various classes of members of the institution on the subject of the admission of women to the class or classes of membership for which they may, apart from the question of sex, be qualified under the present rules of the institution. At the present time women are not eligible under the existing rules covering the admission of candidates. To make their admission possible, therefore, it will be necessary to alter such rules, which procedure requires the assent of a two-thirds majority. If this is obtained, the consent of the Privy Council to the corresponding alteration in the Royal Charter of Incorporation would also have to be obtained. It is understood that at the present moment there are only three women seeking admission into the institution. Each of these applicants has received a technical training and has been engaged in making calculations or carrying out experimental work connected with shipbuilding. One of these applicants is the joint author with a member of the institution of a paper contributed to last year's transactions. This paper, "The Effect of the Longitudinal Motion of a Ship on Its Statical Transverse Stability," by Mr. G. S. Baker, O.B.E., and Miss E. M. Keary, was read recently. If women are admitted, they will only be admitted on the same qualifications which apply to men.

Shipping Developments at Belfast

Definite and interesting information as to the shipbuilding developments now under way at Belfast was communicated by the chairman of the Belfast Harbor Board at one of its recent meetings. During the past year about 150 acres of the harbor estate on both sides of the River Lagan have been let to the local shipbuilding firms, almost doubling the area previously devoted to shipbuilding and marine engineering. About 124 acres have been let to Messrs. Harland & Wolff, Ltd., and 24 acres to Messrs. Workman, Clark & Company, Ltd. On an area of 85 acres of recently reclaimed land on the east side of the Musgrave Channel, Messrs. Harland & Wolff's contractors are now laying out a new shipyard, erecting workshops and installing the necessary overhead equipment. With a water frontage of over 900 feet, there is accommodation for six building berths. On these it will be possible to construct vessels up to and over 1,000 feet. On another area of 40 acres, situated between Musgrave Channel and Queen's Road, the same firm intends to lay down premises for engineering purposes.

Messrs. Workman, Clark & Company have also acquired 24 acres for extensions to their north shipbuilding yard, supplementing the extension carried out about five years ago, at which time the firm laid down two building berths. At present the firm has twelve building berths, five of which are in the south yard. Side by side with this private enterprise the harbor commissioners are embarking on a most extensive scheme of harbor works, including wharves and jetty quays and deepening of channels. The operations incident upon the carrying out of these changes will be spread over a considerable number of years. Parliamentary powers, involving an expenditure of two and one-half million pounds on these works, including the construction of a new graving dock 975 feet long, with an entrance width of 111 feet, have been obtained during the present session.

NEW BOOKS

STORING, ITS ECONOMIC ASPECTS AND PROPER METHODS. By H. B. Twyford. Size, 6 by 9 inches. Pages, 200. Illustrations, 96. New York, 1918: D. Van Nostrand Company. Price, $3.50.

This book, which has been compiled by a man who in his connection with the Otis Elevator Company has had unlimited opportunity to collect valuable data, gives clear specific suggestions for the solution of storing problems. The subjects covered include: Economic Questions Connected with Storing; Specifications, Definitions, and Standardization; Location and Equipment of Storeroom; Appliances for use in the Storeroom; Manual Operations; Clerical Work—Inventories; The Stores Department; Receiving Material; Inspecting and Placing Material in Storeroom; and Deliveries from Storeroom.

THE SHIPBUILDING INDUSTRY. By Roy Willmarth Kelly and Frederick J. Allen, director and assistant director, Harvard Bureau of Vocational Guidance. Introduction by Charles M. Schwab. Size, 5½ by 8 inches. Pages, 302. Illustrations, 103. New York, 1918: Houghton Mifflin Company. Price, $3.00.

Written with the assistance of the Shipping Board and prefaced by Charles M. Schwab, this book may be considered authoritative in all its details. The illustrations include pictures of shipyards and shipyard work over the entire country, covering the chief operations in present-day ship construction. The following headings serve to indicate the scope of the book: A Great National Enterprise, Reviving a Neglected Industry, Products of the Shipyards, From the Blueprint to the Finished Ship, A Glimpse of a Modern Steel Shipyard, Naval Architecture, The Construction of the Hull, The Metal Trades and the Electrical Department, The Woodworking Shops and Yard Maintenance, Executive and Clerical Positions in Shipbuilding, The Building of Wooden Ships, Recruiting and Training the Industrial Army, Future Employment Opportunities in American Shipbuilding.

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

REQUISTIONED SHIPS BEING RELEASED TO OWNERS

Shipping Board's Decision Affects 248 Vessels Aggregating 1,219,000 Tons

Early in January announcement was made by the Shipping Board of the release of requisitioned vessels of 3,000 tons or under from Government control. On January 16 all requistioned vessels, except a few retained for transport service, were ordered to be turned back to their owners. The vessels will be actually released as soon as present voyages have been completed and ships have been docked at American ports. In every case release will be given on each individual vessel, and not as a class or group of vessels. No conditions are placed upon the owners, except that they are obliged to maintain ocean freight rates wherever fixed and announced by the Board.

According to estimates of Shipping Board officials, 248 vessels aggregating 1,219,000 deadweight tons are affected by the Board's decision. In the place of those ships which are retained for transport service, because especially fitted for that purpose, owners will receive an equal tonnage of Government-owned and equipped ships.

With the withdrawal of the American-owned requistioned shipping from the Shipping Board's jurisdiction, those vessels remaining under the Board's control are the few requistioned ships used for transport service as noted above, vessels requistioned on the ways when only partially complete, but title to which was obtained by Government purchase, vessels constructed out of Government funds, and the chartered and commandeered foreign tonnage. The total number of ships owned by the Board is 636, of 2,348,250 gross tons; of which 534, of 1,994,913 tons, are new vessels; 59, of 257,962 tons, are former German ships; 6, of 24,417 tons, former Austrian ships, while 37, of 100,962 tons, are former Great Lakes ships.

Neutral Ships Released

On January 8 the Shipping Board announced that neutral vessels would be permitted to charter to the various time charters as in pre-war times. It is understood that 80 steamships of 478,769 tons requistioned from Dutch owners for the war emergency will also be returned to their owners at an early date, with the same proviso that in cases where former Dutch ships are now in service as transports they will be replaced ton for ton by Shipping Board-owned vessels. The Board also has under requisition approximately 300 steamers of about 1,417,000 tons owned by other foreign Governments than Holland, which will come under this ruling.

British Government Releases Requistioned Ships on March 1

On January 15 the Shipping Controller announced that British ships completing voyages on and after March 1 at ports of delivery in the United Kingdom, or, in exceptional cases, at ports abroad, will be relieved from requisition, except in so far as they are required for Government purposes, or if they are ships to which special conditions apply. With a view to safeguarding the essential imports and exports of the United Kingdom and the Allies, it is explained, it will be necessary for some time to maintain a system of direction as to the employment and limitation of freight rates for essential commodities. The release does not apply to ships wholly engaged in the naval and military services.

French Requistioned Steamers Will Be Returned

Under date of January 12 the French Government announced that all mail steamers requistioned by the Government during the war would be placed at the disposal of their owners before February 15.

SHIPPING VALUES TO BE WRITTEN OFF

Hurley Plans to Cut Off $1,000,000,000 of Total

After extensive investigation, Chairman Hurley, of the United States Shipping Board, has formulated a policy, which has been officially approved, to write off virtually $1,000,000,000 from the cost of American shipping built during the war. A proportionate write-off from the valuation of American shipyards may possibly be included in the finished plan. This write off, which would apply to ships worth approximately $3,000,000,000, would enable American shipping to make rates that would insure successful competition with other maritime nations and keep the seas open to the great business developments expected at the end of the war.

Colby Resigns from the Shipping Board

Announcement has been made of the resignation of Commissioner Bainbridge Colby from the Shipping Board. This resignation, which has been on file since last December, has only recently been made public. Although Mr. Colby felt the necessity of returning to his private business as soon as possible, he has remained with the Shipping Board during the interim, knowing that his services were still necessary. His work as Commissioner has at all times been greatly appreciated by Chairman Hurley and the other members of the Shipping Board.

FIRST SHIPPING BOARD VESSELS ALLOCATED

272,584 Deadweight Tons Already Placed

The Shipping Board released thirty-three vessels for private operation on January 16 to establish important services between New York-Greece, New York-United Kingdom, Philadelphia-United Kingdom, New York-Portugal, New York-North Africa and Egypt, New York-Finland, New York-West Africa, New York-South Africa, New York-Dutch East Indies, New York-Australia and New Zealand, New York-Philippines, China and Japan, New York-India, New York-Bahia, Blanca, Port Madry and Punta Arenas, and New York-Antwerp.

These vessels, aggregating 272,584 deadweight tons, were distributed among thirteen companies. The allocation of this tonnage (which is understood to cover all tonnage available for export purposes at this time) will afford considerable relief to exporters.

Committee to Formulate Peace Policy of the Emergency Fleet Corporation

Before his resignation, Commissioner Bainbridge Colby announced the following men as composing the personnel of the committee which has been formed to examine the building plans of the Emergency Fleet Corporation and formulate a peace policy:

J. A. Farrell, president of the United States Steel Corporation; P. A. B. Franklin, president of the International Mercantile Marine Company; George S. Dearborn, president of the American-Hawaiian Steamship Company; H. H. Raymond, president and general manager of the Mallory Steamship Company, and F. D. M. Strachan, president of the Strachan Shipping Corporation. In addition to the foregoing, Charles Piez, director general of the Emergency Fleet Corporation, and John Rosseter, director of operations of the United States Shipping Board, will be ex-officio members. George S. Dearborn and H. H. Raymond serve as the nominees of the American Steamship Association.

France Would Build 2,000,000 Ship Tons in American Yards

The governing committee of the French Naval League, in which are represented shipowners' and seamen's associations, have asked that opportunity be given French owners to purchase immediately 1,000,000 tons of shipping built in England and 1,000,000 tons of shipping built in the United States, and that American yards be opened to French owners for the immediate construction of 2,000,000 tons of cargo steamers.

MATERIAL HANDLING MACHINERY MANUFACTURERS ORGANIZE

New Association to Improve Freight Handling Facilities at Marine Terminals

In order to aid the Government and private interests in improving freight handling facilities at marine terminals, twenty-five of the large manufacturing companies which build mechanical freight handling devices, formed an association on January 16 at the Hotel McAlpin, New York, to be known as the Material Handling Machinery Manufacturers' Association. It is expected that the membership of the association will rapidly increase. As formed the association embraces five distinct lines of freight handling equipment: (1) Cranes, hoists and winches; (2) power and gravity conveyors; (3) elevators; (4) trucks, trailers and tractors; (5) bulk freight handling machinery.

Calvin Tompkins, formerly dock commissioner of New York City, was elected president of the association, and James A. Shepard, president of the Shepard Electric Crane & Hoist Company, Montour Falls, New York, vice-president. The other officers elected for the ensuing year were: Treasurer, Lucien C. Brown, Elwell-Parker Electric Company, Cleveland, and temporary secretary, Fred Stadleman, Wellman-Seaver-Morgan Company, New York. The management of the association will be in the hands of a board of governors, numbering eight members, which later will be expanded to twelve. The board of governors is comprised of the following:

C. M. Watson, Watson Elevator Company, New York.
William Clarke, Manning, Maxwell & Moore and Shaw Electric Crane Company, New York.
R. W. Scott, Otis Elevator Company, New York.
F. W. Hall, Sprague Electric Works, New York.
Fred Stadleman, Wellman-Seaver-Morgan Company, New York.
Lucien Brown, Elwell-Parker Electric Company, Cleveland.
James A. Shepard, Shepard Electric Crane & Hoist Company, Montour Falls, N. Y.
John C. Walter, Alvey-Ferguson Company, Cincinnati.

The first meeting of the association on January 15 was taken up with the business of organization, and was followed on the 16th by a luncheon at the Hotel McAlpin, at which Hon. William C. Redfield, Secretary of Commerce, was the guest of honor and principal speaker.

Secretary Redfield emphasized the fact that handling charges at terminals is the biggest expense and also the biggest waste in transportation. He contrasted the highly developed terminal facilities for handling bulk freight on the Great Lakes, which make the Great Lakes steamship the cheapest freight carrier in the world, with the poorly developed and wasteful facilities at our seacoast ports, and asked the new association to co-operate with the Government in bettering these conditions.

Other speakers at the luncheon were Calvin Tompkins, former dock commissioner of New York, and J. W. Frazier, of the engineering staff of the Docks and Harbors Facilities Commission of the Shipping Board. James Shepard, president of the Shepard Electric Crane & Hoist Company, presided at the luncheon.

JAPAN HAS CONTRACTS FOR THIRTY-FOUR AMERICAN SHIPS AT $100,000,000

Shipping Board Lets New Contracts for Ships, Barges and Tugs

Although contract was let in July, 1918, details have just been made known of the proposition to have Japan build thirty-four cargo ships for the United States Shipping Board at a cost of $100,000,000. Thirty will be built at Kobe and four at Shanghai, China. China has contracted independently to build eight steel cargo vessels at Shanghai to cost $32,000,000.

A special order, signed by Howard Coonley, vice-president of the United States Shipping Board Emergency Fleet Corporation, under date of December 18, 1918, announces the execution of new contracts during the weeks ending October 19, 26, November 2, 9, 16, 23 and 30, 1918. Reports of these contracts have been held up pending determination of the corporation's programme of cancellation.

The new contracts include a number of barges, several cargo ships, ranging from 3,500 to 10,300 deadweight tons, ocean-going and harbor tugs and one schooner of 3,200 deadweight tons. The schooner is to be built by the Long Beach Shipbuilding Company, Long Beach, Cal.

The largest ship included in the new contracts is a 10,300-ton transport to be built by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va.

The contract of the Southern Shipbuilding & Dry Dock Company to build sixteen wooden vessels for the Government, which was canceled after the sign-

The Steamship *Northern Pacific*, Which Was Stranded on a Sand Bar Off Fire Island with 2,247 Troops Aboard

ing of the armistice, has been reinstated. All these vessels are of the Daugherty type. The vessels will be built at the Orange, Tex., yards, but equipped with machinery at Galveston.

The Macdonald Engineering Company, Chicago, Ill., about which a preliminary report was given in the January issue, has a contract for building concrete fuel oil barges at Aransas Pass, Tex., for the France & Canada Steamship Company, 120 Broadway, New York. It is planned to build ten barges as quickly as possible and to contract for others later. Each barge is to be 270 feet long, and to have a carrying capacity of 12,500 barrels of oil. The France and Canada Steamship Company is planning to spend one million dollars in building these barges, which are to be used in the oil-carrying trade between Aransas Pass and Tampico, Mexico.

The Bullock-Caldwell Shipbuilding Company have two 1,800-ton auxiliary schooners under construction at Pensacola and Milton, Fla., in addition to the 1,800-ton auxiliary schooner at the Coyle shipyard.

The Douloutt & Williams Shipbuilding plant, New Orleans, La., will build seven ships of 9,600 tons burden, in all a contract for $15,000,000. To-day Douloutt & Williams have a large shipbuilding plant, representing an investment of over a million dollars. A settlement has grown up in the swamp, office buildings have been erected, a power house sufficient to operate the entire plant is almost completed, and the shipyard itself is firmly established.

The Texas Steamship Company, Bath, Me., is placing orders for materials for seventeen ships which are to be built at once. A total of thirteen vessels were successfully launched by that company during 1918.

The Norway Pacific Shipbuilding Company, Everett, Wash., has received an order from the Coast Guard Service, Washington, D. C., to build five revenue cutters at a total price of $3,435,000.

Reports intimating that the $6,000,000 contract for steel barges and towboats for the Federally-operated Mississippi and Warrior River barge lines would be suspended have been formally denied by a telegram from the Railroad Administration.

The Cunard Line, Liverpool, England, has ordered contracts for English shipyards to build four sister ships to the *Carmania*.

Ten 12,000-ton passenger vessels will be built by the Robert Dollar Company for service between San Francisco, Hong Kong, Shanghai and Manila in competition with the Toyo Kisen Kaisha and Pacific Mail. Contracts will be placed as soon as prices decline. The estimated cost of the fleet will be $10,000,000.

The Halifax Shipyards, Ltd., Halifax, N. S., have received contracts from the Dominion Government for the construction of ships aggregating 10,500 tons.

The Nova Scotia Steel & Coal Company will construct ships of 5,000 tons for the Dominion Government as soon as the contracts are completed.

The Nippon Yusen Kaisha has issued contracts to the Mitsu Bishi shipbuilding yard for the construction of three cargo ships of 10,000 tons deadweight. It is expected that these vessels will be ready for ocean service by the summer of 1919.

Freight Rates Obtainable from Shipping Board

The Division of Operations of the United States Shipping Board is prepared to name freight rates for all overseas trades, both outward and homeward; also through rates from foreign markets via United States or direct to all world's markets in cargo or parcel lots. To meet the cut in transatlantic freight rates made by the British Ministry of Shipping, the U. S. Shipping Board announced on January 27 a reduction of about 66⅔ percent in charges between Atlantic ports and the United Kingdom, France, Italy and Belgium.

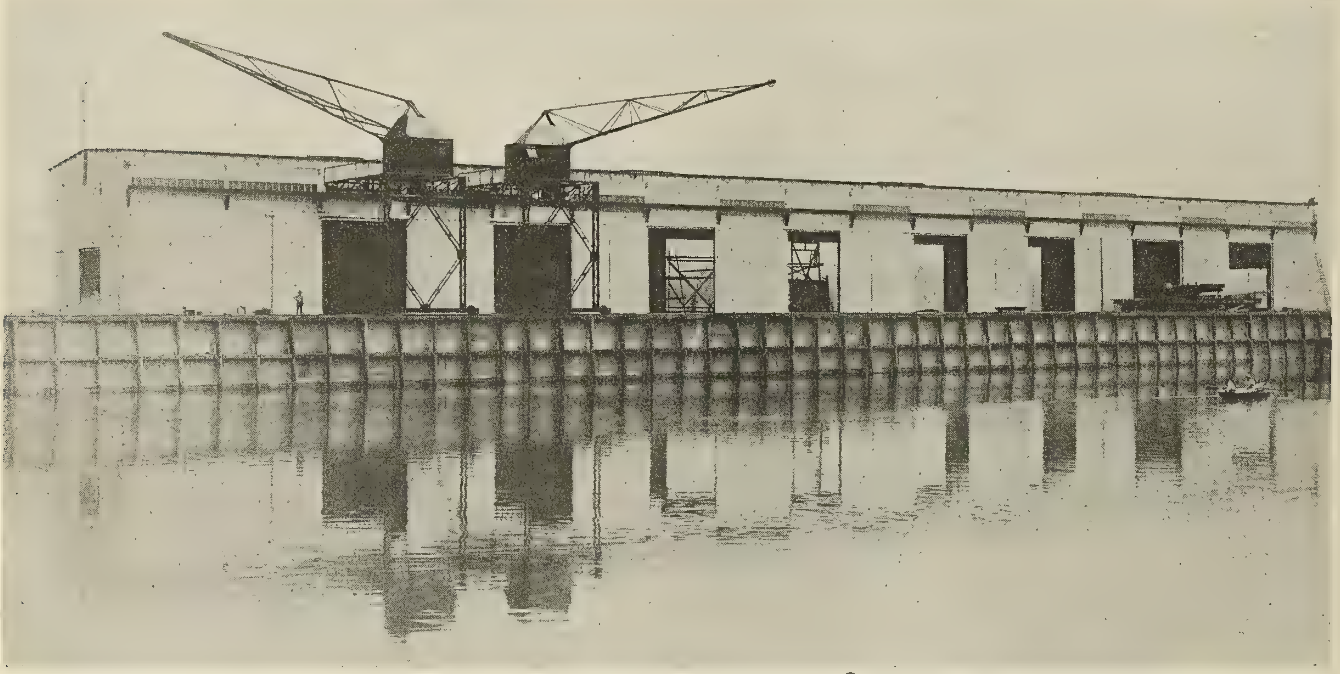
Boston's Dock Improvements

More than thirty options to sell land, buildings and a wharf at Jeffries Point, East Boston, are reported, thereby disclosing an undertaking in that city which, when completed, may rival the Bush Terminals of Brooklyn. Another drydock under way in East Boston, which involves the expenditure of $3,000,000 to $5,000,000, includes an electric railway, which will supply the mile and a half of warehouses along the stretch of port development.

Port Beaumont Terminal

A few years ago there was only a depth of about 7 feet of water to the city of Beaumont, located some 52 miles from the Gulf of Mexico. Here a channel of 26 feet was dredged, and a marine terminal was constructed of modern design and with permanent works, concrete quay walls, which are fireproof, rat proof and decay resisting, coordinated railway tracks between the shed and the edge of the quay, a steel shed and the latest mechanical appliances —the external traveling gantry jib cranes for discharging and loading the ships, and internal cross traveling cranes for assorting, distributing and tiering the freight.

At the end of the first seven months the terminal was earning 4 percent. The following figures, now that the war censorship is removed by the Government, reveal the fact that in the nearly nineteen months, during which time knowledge of the coming and going of vessels was denied the world, 552 steamers sailed into the Beaumont harbor and carried away over 2,000,000 tons of cargo. To foreign ports, 167 steamers carried 661,310 tons, and they brought into Beaumont 73,280 tons. To coastwise harbors, 385 steamers carried 1,075,625 tons, and they brought into the local port 221,875 tons of freight. Such a record has not been equaled under similar conditions at any American port.



View of the Terminal Warehouse Which Handled Large Freight Shipments at Beaumont, Texas, During the War

NEW SHIPYARDS AND EXTENSION OF EXISTING YARDS

Report of Shipbuilding in Maine and Canada

The Perth Amboy Dry Dock Company is planning for the construction of a large drydock of about 12,000 tons capacity, with shipbuilding and repair facilities at the recently-acquired plant of the Raritan Dry Dock Company. This property has been operated for some time past by James Shewan & Sons, Brooklyn, N. Y., who are now removing the equipment to their Brooklyn works. The new drydock will be of sectional type, having five sections, each 85 feet long and 125 feet wide. The plant will be equipped with machinery for the construction of steel vessels, as well as for the repair of both steel and wooden ships. D. Preacher is chief engineer. The State Board of Commerce and Navigation has recently granted the application of the company for a grant of lands now under water on Staten Island Sound for a consideration of about $25,000. It is understood that this property will be used by the company in connection with its proposed works activity.

Improvements at the Philadelphia Navy Yard

The Navy Department, Washington, D. C,. is making substantial progress in construction and improvement work at the Philadelphia, Pa., navy yard. An appropriation of about $20,000,000 has been made available for this work, it being proposed to make this yard one of the largest and most important of the Government plants in this country. Of this appropriation approximately $5,000,000 will be employed for the construction of a large drydock, work upon which is now under way. This dock will be about 210 feet wide by 1,064 feet long, with facilities for handling two vessels at the same time. It will be augmented by a comprehensive railway system and extensive shop facilities. About $3,000,000 will be used for the construction of a six-story machine shop, including a department for handling different features of structural steel work, a forge shop about 300 by 690 feet, a foundry about 490 feet long, a galvanizing plant, a pattern shop, and a number of other structures. This last noted sum will also be utilized, in part, for the construction of two new 900-foot shipways, with cranes and other necessary apparatus.

In addition to the improvements of the Bethlehem Shipbuilding Corporation, Sparrows Point, Md., mentioned in the January issue, that company has commenced the erection of a number of new shop buildings at its works to increase the present operating facilities. The structures will include a one-story addition to the layout shop, about 45 by 425 feet, a one-story extension to the fabricating works, a one-story addition to the electrical shop, and other buildings. New equipment will be installed in the machine shop. It is also planned to equip the present boiler works with new machinery as required.

The Federal Shipbuilding Company, 30 Church street, New York, a subsidiary of the United States Steel Corporation, is planning to construct a large drydock with shop facilities at its shipbuilding plant at Kearny, N. J. The company has arranged to continue the operation of this plant following the completion of Government contracts, and it is understood that a number of all-steel vessels will be built for the parent organization. The new drydock will be located on property recently acquired on the Jersey City side of the Hackensack River, comprising about 85 acres of land, while a second strip of land, 90 by 225 feet, near the Lincoln Highway, has also been purchased for works purposes. The present works comprises twelve shipways, on a site embracing about 160 acres of property. Eight vessels have been launched up to the present time, and three completed ships turned over to the Government. The yard is now giving employment to close to 9,000 persons. L. H. Korndorff is general manager.

The Bureau of Yards and Docks, Washington, D. C., is planning for the immediate construction of a new machine shop at the Brooklyn, N. Y., navy yard, to be used for light machine operations and electrical work. The structure will be erected by the Hinkle Iron Company, 534 West Fifty-sixth street, New York. Bids were recently rejected by the Department for the construction of a new locomotive shop at this yard, and it is understood that new quotations will be asked at an early date.

Reports from the New London Ship & Engine Company, New London, Conn., show that work at this plant is still operating at good caapcity. All the skilled machinists will probably be retained indefinitely. Night work and "top speed" gait have necessarily been abandoned.

The Astoria Marine Iron Works, Astoria, Ore., which specializes in marine repair work, plans a number of improvements to its plant, including installation of machinery.

The Skinner & Eddy Corporation, Seattle, are working on plans to build a blacksmith and power house, 100 by 229 feet, to cost $4,500, and a fitting-out shop, 30 by 120 feet, to cost $7,000.

The Marine Repair & Construction Company, Portland, plans to add four shipways to its plant in the near future. It specializes in repairing hulls and rebuilding scows.

J. A. Taylor and associates, Anacortes, Wash., have purchased a site in that city on which will be erected a shipyard and repair plant for small vessels.

The Bureau of Yards and Docks, Navy Department, Washington, has had plans prepared for extensions to the naval station at Lake Denmark, N. J., to cost about $100,000. It is also planning to build an oxy-acetylene works at Charleston, S. C., to consist of main manufacturing plant to cost $25,000, refrigerating plant to cost $100,000, general service building, $25,000, fuse works and other structures.

The Buffalo Dry Dock Company, Ganson street, Buffalo, has filed plans for a one-story pipe-bending shop, 20 by 26 feet.

The North Country Shipbuilding Corporation, Ogdensburg, N. Y., recently organized, with E. J. Burns at the head, is holding in abeyance plans for its proposed new shipbuilding plant to cost about $150,000.

The West Shipbuilding Company, Wilmington, Los Angeles, Cal., is planning to enlarge its yard.

The Spedden Shipbuilding Company, Baltimore, Md., plans the immediate rebuilding of a portion of its shipyard recently destroyed by fire, at a loss said to be $200,000.

The Norfolk-Hampton Roads Dry Dock & Repair Company, Norfolk, Va., is reported to have let a contract to James Stewart & Company, New York, for the construction of a large plant at Lambert's Point, Va., to cost several million dollars.

The Bruce Dry Dock Company, Pensacola, Fla., is planning for a new drydock with ship repair and construction facilities to cost about $500,000.

Arrangements are being completed by the French-American Shipbuilding Company, Los Angeles, Cal., for building a shipyard, consisting of four shipways, with shops, etc., at San Pedro, Los Angeles harbor, for building steel concrete vessels.

The San Diego Shipbuilding & Dry Dock Company, San Diego, Cal., has received permission from the City Council to establish a shipbuilding and repair plant on the tidelands between First and Fourth streets. The project will cost over $100,000. Adam F. Wecklar is president of the company.

The Moore Shipbuilding Company, Oakland, is negotiating for a number of machines. The Union Construction Company, Oakland, is also contemplating the erection of a plant to build marine engines. It is reported that if the company secures the contract which it is seeking it will at once come into the market for about $50,000 worth of machine tools.

A new electric power plant has been begun at the Savannah, Ga., shipbuilding plant of the Foundation Company. This plant is building all-steel vessels of the trawler type for the French Government.

The Mobile Shipbuilding Company, Mobile, Ala., has acquired sixteen more acres of land adjoining its yard, and will build additions to its shops, so as to equip the yard for the construction of steel vessels.

The Union Shipbuilding Company, Fairfield, Md., is said to be planning to spend $2,000,000 in building four covered concrete shipways and other expensive additions to its present plant, with an electric crane installation to operate between the different ways. The company is planning to arrange facilities for the construction of fourteen vessels at one time, and it is said that when the present work is completed the plant will be one of the largest in this part of the country. It is planned to employ about 3,000 men at the works when complete facilities are available. Recent contracts for construction work have been awarded to the Hughes Foulkrod Company, Philadelphia, Pa. The Union Shipbuilding Company is operated by the McClintic-Marshall Company, Pittsburgh.

The Downey Shipbuilding Corporation, of Arlington, Staten Island, which has been announcing for the past month or so its availability for the construction of special steel freighters, proposes to increase its present capacity to 120,000 deadweight tons. The construction of a new two-story building at its

plant, about 25 by 158 feet, to cost $15,000, is also contemplated.

Extensions and alterations of the machine shop of the Lighthouse Department, United States Government, at Tompkinsville, Staten Island, are in contemplation, which will cost about $45,000.

The City Council, Los Angeles, has approved a bond issue of $4,500,000, for improvements at the city harbor, San Pedro and vicinity, which will include the installation of cranes and other machinery for hoisting, loading and unloading materials and grain elevators.

The Standard Shipbuilding Company has secured from the New Jersey Board of Commerce and Navigation, a tract of land, 1,800 by 590 feet, on the north side of Shooter's Island, where it is expected there will be a further development of the plant. The price was $45,900.

It is reported that application will shortly be made for the construction of a large dry dock at Vancouver, B. C., to cost at least several million dollars, to be developed under the provisions of the Dry Dock Subsidy Act. No formal request has as yet been made for subsidy. It is stated that the drydock is to be built by a combination of Vancouver parties, including the Lyall Shipbuilding Company and the Pacific Construction Company.

The Kill Von Kull Shipbuilding Corporation has been incorporated, and is planning the construction of a shipyard on Staten Island, where it is reported a site has been purchased. The company is represented by Gilbert & Gilbert, 43 Exchange Place, New York.

Maine Yards Forging Ahead

During the year just ended the total tonnage constructed in Maine amounted to 28,000 gross. In Portland alone four wooden steamers have been built by the Cumberland Shipbuilding Company, and six by the Russell Shipbuilding Company, all of the Ferris type, boats of about 3,500 tons deadweight capacity. Several other steamers have been built or are in the process of construction in Portland and the vicinity, and at Sandy Point two hulls are under construction, all for the Emergency Fleet Corporation, with the exception of one small craft that was built at South Portland for the Greek account. In addition to the above, nineteen schooners, aggregating about 16,000 tons net register, have been launched, and a considerable fleet is on the stocks, including several yet to be launched.

A five-masted schooner, the *Jennie Flood Kreger,* in the Frost yard at Belfast, a vessel of 2,200 tons, will probably reach the water by February 1. At Thomaston, the Atlantic Coast Company have already launched two schooners, and are hurrying work on the third. The Texas Steamship Company at Bath, who has thirteen vessels to its credit for last year's efforts, has now on the ways four steel tanker steamers and three motor barge tanks.

The Kelly-Spear Company at Bath is building for the Government two barges of 2,500 tons capacity each, and one of 3,800 tons capacity for the Staples Coal Company. The G. G. Deering Company has a large schooner already well advanced; Percy & Small will have a five-masted schooner of 3,000 tons capacity, which will probably be ready in May.

The frame has also arrived for a four-master to be built in the W. T. Donnell yard, now operated by Pendleton Bros., Inc.

Freight rates for long-distance voyages are still high in this locality. Recent charters of schooners carrying lumber to Buenos Ayres rate at $69, $65 and $52.50 per thousand; rates for a schooner carrying lumber from St. John to Barbadoes were at $20.

Canada's Extensive Production

Up to the end of November Canadian shipbuilders had built for Canadian registry during the war 199 sailing vessels of 44,135 gross tons and 160 steel ships of 69,612 gross tons. For the Imperial Munitions Board fifteen ships of 1,440 net tons each and seven of 2,600 net tons were built. The Dominion Government is having forty steel ships built under contract, aggregating 255,250 tons. Two of these have been launched. The total capacity of Canadian yards is 450,000 tons per year.

The National Shipbuilding Company, Goderich, Ontario, is in the market for a radial drill, lathe, air hoist, lift with trolley and a vertical air receiver for the plant.

The Annapolis Shipbuilding Company, Annapolis Royal, N. S., has started work on a repair dock to handle vessels up to 5,000 tons.

The Halifax Shipyards, Ltd., Halifax, N. S., which recently increased its capital stock from $6,000,000 to $10,000,000, is making rapid progress on its new plant. The company has received orders from the Dominion Government for the construction of vessels of 10,500 tons.

Two steel ships to be built by the Nova Scotia Steel & Coal Company, New Glasgow, N. S., for the Dominion Government will be of 2,800 tons each, and plans are being made to construct ships of 5,000 tons as soon as the present contract is completed. This will probably necessitate extensions to the plant and additional equipment.

The Empire Drydock & Contracting Company, Prince Rupert, B. C., plans the erection of car ferry shops at an early date.

$9,870,000 IN NEW SHIP FIRMS DURING DECEMBER

January Incorporations Show Steady Activity

During December twelve shipping and shipbuilding companies, with an aggregate capitalization of $9,870,000, were incorporated, which indicates that although the actual war necessity has passed, interest in shipbuilding and ship operation is still "on the move." These incorporations include:

American Steamer Corp., Del.	$1,000,000
Boston Dry Dock & Construction Co.	1,000,000
Erickson Navigation Co., Del.	250,000
Empire Ship & Dry Dock Corporation, Delaware	1,500,000
International Steam Navigation Co., New York	100,000
Progress - American Steamship Line, Inc., New York	100,000
Russian-American Steamship & Freighting Co., New York	100,000
Schooner Friendship Corporation, New York	50,000
Southland Steamship Co. of Delaware, Del.	5,000,000
Seven Seas Boatbuilders' Corporation, Washington	500,000
West Shipping Co., New York	150,000
Total	$9,870,000

The Graham Shipping Company, of New York, has been incorporated by M. L. Pehlan, L. Barker and P. H. Graham, with a capital of $250,000, to do a custom house brokerage business.

The Los Angeles Pacific Navigation Company has been incorporated, with a capital of $1,000,000, for carrying on commerce between the American Pacific Coast and foreign ports. L. B. Sale, former president of the Chamber of Commerce, will serve as president. Paul Shoup, vice-president of the Southern Pacific, and president of the Pacific Electric, will serve as vice-president. Representatives of the corporation are arranging for the allocation of from three to five ships of the Emergency Fleet Corporation to Los Angeles harbor. The Lakes & Oceanic Barge & Transit Company, Auburn, Me., has been incorporated, with a capital of $100,000, to manufacture barges and vessels. J. A. Pulsifer, F. E. Ludden and Z. D. Abbott, Auburn, are the incorporators.

The Scotia Shipbuilding Company, recently organized to take over the Milton Shipbuilding Company, assumed control of the plant and holdings of that concern at Yarmouth North, December 24.

A new shipbuilding concern to be known as the Duffy, Blinn Company, has just been established at Saulnierville, Digby county, N. S., and will at once start getting the property which they have acquired for a shipyard ready for building operations. The promoters of the company are Capt. John Duffy, who has just returned from several years at sea, and Edward Blinn, who for some years has maintained an enviable record as a spar maker in many Canadian and United States shipyards.

The United Marine Construction Corporation, 15 Whitehall street, New York, has increased its capital from $200,000 to $1,000,000.

The Bankers' & Shippers' Insurance Company of New York is a new firm, with a capital of $1,000,000 and a surplus of $1,500,000, which has been organized to handle marine and fire insurance. The underwriting will be done by an organization to be known as the Maritime Underwriting Agency. Many prominent interests are identified with the organization, among them the Guarantee Trust Company, the du Pont Powder interest, the Chase Securities Corporation, the Barber Steamship Company, and Willcox, Peck & Hughes, insurance brokers.

Roy H. Robinson, 79 West Monroe street, Chicago, is promoting the organization of a company to build a new type of concrete ships at New Orleans.

A new dockyard company is being promoted at Itozaki, on the Inland Sea, in Japan, with a capital of 3,000,000 yen. It is planned to build or manufacture ships, boilers, tools, machines and other goods, and also to salvage or repair steamers. Four docks, each capable of accommodating vessels up to 10,000 tons, are to be constructed.

Powerful Hammers Useful in the Shipyards

Bradley hammers, which vary in weight from 800 to 13,200 pounds each, and carry heads ranging in size from 15 to 500 pounds, have found their place in the diversified work of the shipyards. These power-driven hammers, built by E. C. Bradley & Son, Inc., of Syracuse and New York, in cushion helve, upright strap, upright helve and compact types, are capable of forging iron, steel and other metals from 5 inches square down, at the rate of 175 to 450 blows per minute.

The accompanying illustrations show punches and chisels made by these hammers right from the bar stock and finished to within 0.010 inch of exact size. Hammer punches made in this manner

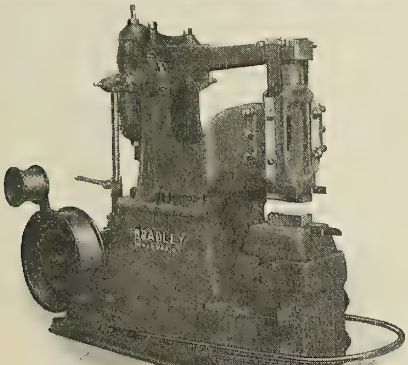


Fig. 1.—The Bradley Hammer

present a harder and denser cutting edge than turned tools, and have the additional merit of being produced without waste of stock, since the excess metal from one operation is completely utilized in the next. A 200-pound Bradley hammer in use at the Fore River Shipbuilding Company, Quincy, Mass., produced 300 wedge-shaped plate steel ship liner forgings per nine and one-half hour day. These parts ranged from 2 to 5 inches in width, with thicknesses up to ⅜ inch.

Fig. 2.—Chisels Made in the Shipyards by Bradley Hammers

Pneumatic hammer chisels and calking irons are also quickly fashioned with the Bradley hammer. Except for the grinding of the cutting edge and tempering, the former tools may be completely shaped and finished in the yards. By keeping a water spray on the piece which is finished "black hot" a fine finish can be obtained.

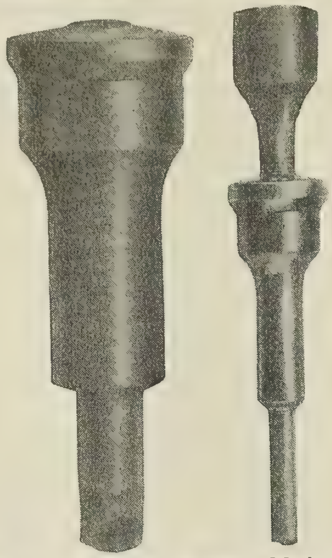


Fig. 3.—Pneumatic Punches Made by Bradley Hammers

Waterproofing Concrete Ships

It is natural that in the development of the concrete ships various methods should be tried out for waterproofing. Among new materials offered, bituminous preparations have been found quite satisfactory for this purpose. In fact, this was specifically mentioned by Rudolf Wig, naval architect, at the annual meeting of the Society of Naval Architects and Marine Engineerings in November, 1918. The ordinary bituminous varnish adheres fairly well to dry cement, and two or three coats of it give a fair covering. This preparation is subsequently coated with spar varnish, so that other paints may be applied, since the ordinary bituminous preparations in use are frequently dissolved by the paints, which are later applied to the surface previously dried.

A new bituminous solution, however, it is claimed, has been discovered by the William Cail Bitmo Company, 18 Broadway, New York, which penetrates to some extent into the actual structure of the concrete. This property of absorption naturally makes it possible for the applied material to obtain a better grip on the concrete and insures an efficient waterproofing, even if the exterior surface covering is chafed off. The process recommended by that company provides for an application of two or three coats of a special solution in quick succession. After this is thoroughly dried a finishing coat of especially prepared solution is applied. This latter coat, the company claims, will not be dissolved by other paints.

Steam Jet Air Pump Patent Changes Hands

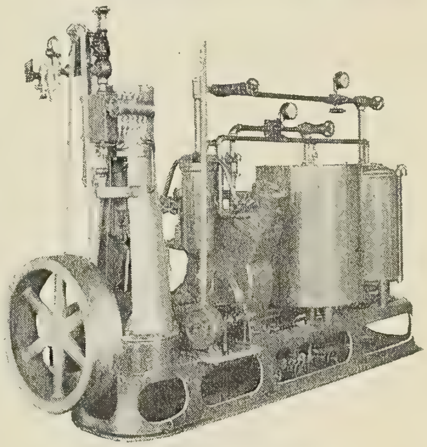
Through the Alien Property Custodian the Wheeler Condenser & Engineering Company, of Carteret, N. J., have obtained from the Schutte & Koerting Company, of Philadelphia, the exclusive right to manufacture and sell steam jet air pumps under Patent No. 968,926, in connection with surface condensers, jet condensers, barometric condensers, vacuum pans and evaporating apparatus. The patent covers the feature of two or more steam jets working in series with a condenser between the jets.

Refrigerating Machine Unit

Recent orders from the Emergency Fleet Corporation and prominent shipbuilding concerns for the refrigerating unit, illustrated herewith, indicate that this machine is meeting with the approval of shipbuilding refrigeration experts.

The advantages of this type are obvious, as the assembly of the engine, compressor, trap, condenser, cooler, circulating pump and liquid receiver, together with the necessary controlling valves, gages, relief valves and piping area upon a single cast iron base economizes time and labor. This method of construction not only conserves space but eliminates much of the usual skilled labor required for the installation on shipboard. This feature is of especial interest to shipbuilders who prefer to make their own installation, although the Refrigeration Engineering Company, of Toledo, Ohio, makers of the new unit, will contract for the complete installation if desired.

Several unusual mechanical features



New Refrigerating Unit

are incorporated in the design of this machine. The compressor is of the two-cylinder type, with valves of large area. A breaker valve is located in the piston head to relieve the vacuum, thus insuring cool cylinder walls. The condenser and cooler are both of the counter-current, submerged coil type, with areas greatly in excess of the capacity required. The positive acting rotary circulating pump is operated by a silent chain, driven direct from the main shaft. The engine is provided with a positive sight-feed oiling system for all bearings, and is of unusual slow speed, for machines of this small size, being operated at 140 to 180 revolutions per minute. A new type scuttle butt of exclusive design is used. It is provided with cast iron heads, and the hand hole is so located that the scuttle may be easily flushed and cleaned.

Since all of the apparatus is assembled upon a single base, the complete outfit can be subjected to an exhaustive refrigeration test under actual operating conditions before shipment.

New Courses for Naval Architects, Engineers and Ship-Workers

The University of Michigan has introduced an intensive training course in naval architecture. The course, which began January 6, 1919, will run for eleven weeks.

In preparation for the American after-the-war merchant marine, the United States Naval School of Turbine Engineering has been established at the Carnegie Institute of Technology, Pittsburgh, Pa., under direction of naval officers. Several detachments of naval men, who have seen service as engineers of steamers operating reciprocating steam engines, have begun the course.

The Connecticut State Trade School has been conducting courses in shipfitting and blueprint reading as applied to the shipbuilding trade, at 785 Main street, Bridgeport, Conn.

The Young Men's Christian Association has been conducting courses in shipbuilding under T. H. Ascherfield, of the Maryland Shipbuilding Company, in Baltimore, Md.

The United States Government Employment Service at New London, Conn., has opened a course in blueprint reading for ship workers under the direction of Frederick J. Trinder, State director of vocational education. Shipfitting is also being taught to special classes.

Young men, 18 to 35, who have worked in machine shops, have an opportunity to acquire the trade by enlisting in the United States Naval Service for an instruction course at the Government Machinists' School, Charleston, S. C.

Fix Compensation for Ship Management

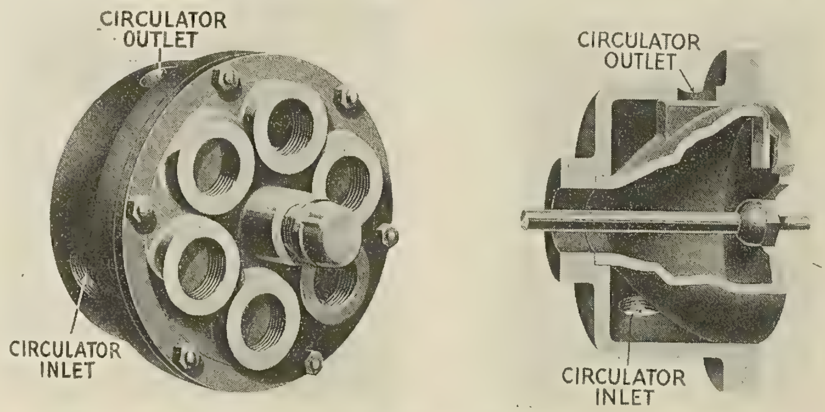
The operating agreement representing the contract form to be used in the assignment of Government-controlled tonnage to private interests was issued on December 18, 1918. On January 7 the managing agreement was made public. In introducing the latter, J. H. Rosseter, director of operations of the Shipping Board, summarized the text as follows:

The managing agreement defines the rights and duties of the manager as to the managing and husbanding of vessels assigned thereunder. It embraces all ships owned by or under bare boat requisition or charter to the Shipping Board, which have been assigned to private companies to man, provision and maintain in good repair for Government account.

In general, the agent under the operating agreement, is to attend to all those things customarily attended to by a time charterer of a vessel, and the manager under the managing agreement is to attend to those things customarily attended to by the owner of a vessel under time charter. So far as practicable, it is the Board's plan to have the company act as manager and as operating agent of a given vessel. Where this is not done the manager and the operating agent will be expected to work in the closest harmony. The agent will be expected to maintain a first-class operating organization with the requisite staff of freight agents, accountants and executive officers. The manager will be expected to maintain an efficient marine department. The usual and customary duties of a ship's operating and managing agents are to be performed by the agent and the manager, without extra charge, for the compensation specified in the agreement. No additional expense for overhead, fixed charges, services of general employees, or for the usual facilities maintained by well-equipped operating and managing companies are to be charged to the Board.

Geyser Self-Actuated Boiler Cleaner

Simplicity is the basis of the action of the Geyser circulating boiler cleaner,



Figs. 2 and 3.—Showing Exterior and Cross-Sectional View of Valve Chamber

which is designed for use with Scotch marine boilers. Fig. 1 shows the details of the apparatus as installed in a two-furnace Scotch boiler. The principle of operation is as follows: The valve chamber placed at the top of the boiler is provided with three ports, one on each side and one at the top. The ports on the side are fitted with pipes that terminate at their lower end in the bottom of the boiler. The heat which is imparted to all water above the grate line, when steam is being raised in a Scotch boiler, soon raises the temperature of the water. The valve chamber, situated in the position where the water becomes the hottest, absorbs this heat and conducts it to the water contained within the chamber. As the water in the chamber expands and its specific gravity changes, it soon rushes out through the circulator outlet, shown in detail in Figs. 2 and 3; the chamber is continuously refilled from the water drawn by the conductor pipes from the bottom of the boiler.

It is obvious, therefore, that a continuous water circulation is assured by the Geyser system as long as the temperatures at the top and bottom of the boiler vary. In actual operation, communication is opened between a collecting nozzle (the turning of the handle on the valve shaft, until the pointer is even with the numbers indicated on the dial plate, determines which nozzle shall be operated) and the main blow-off pipe by adjusting the main blow-off valve. The pressure on the boiler and the efficient shape of the collecting nozzle produce a sweeping current of water, which by actual test is shown to extend approximately 6 inches on each side of the collecting nozzle. When all sediment and scale are removed from that part of the boiler to which the collecting nozzle sprays, the pointer on the dial is turned to operate another nozzle. It is allowed to remain in this position until all solids are removed, when the operation is repeated until a complete revolution is made. In this way all sediment and scale-forming ingredients are removed from the bottom of the boiler.

The valve control is particularly valuable when operating boilers in harbor, river or shoal water, especially when vessels are backing or filling and mud and sediment are being stirred up by the propeller wheel.

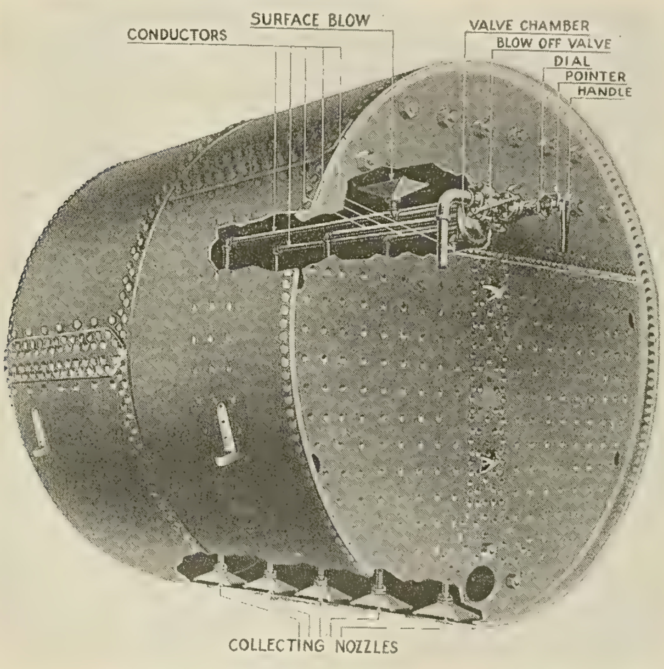


Fig. 1.—Showing Installation of Geyser System in a Scotch Boiler

Chairman of Port and Harbor Facilities Commission, E. Carry, Resigns

Announcement was made on January 5 of the resignation of E. Carry, chairman of the Port and Harbor Facilities Commission of the United States Shipping Board. On October 9, 1917, Mr. Carry became director of the division of operations. This department was invaluable in its service of assembling information in regard to the location and daily movements of every merchant vessel operated by the War Department, the Navy Department and the Shipping Board. About June, 1918, he severed his connections with the division of operations to take the chairmanship of the commission from which he has just resigned. He will return at once to the firm of Haskell & Baker Car Company, Inc.

Canadian Railways Plan to Complete Fifty Ships

D. B. Hanna, of the Canadian Northern Railway, has given out that the Government will eventually operate a fleet of at least fifty ships on transatlantic trade in connection with the railways.

National Foreign Trade Council Convention

The National Foreign Trade Council will hold its sixth national foreign trade convention at the Congress Hotel, Chicago, on Thursday, Friday and Saturday, April 24, 25 and 26, 1919. The formal call will be issued shortly by the chairman of the Council, James A. Farrell, president of the United States Steel Corporation.

Twelve Freight Steamships Taken for Transports

Twelve former freight steamships of the American-Hawaiian and Luckenbach lines have been taken over and equipped as transports, with a combined troop-carrying capacity of 19,000 to 20,000 men by the United States army transport service, it has been announced.

Freight Movement Increases

A report of the Exports Control Committee of the Railroad Administration shows a steady increase in the overseas movement of freight since the signing of the armistice, with an incidental accumulation at some Atlantic and Gulf ports. Most of this excess is at the North Atlantic ports, where 5,722 cars were received over December deliveries.

Heyworth, Wood Ship Division Manager, Resigns

The resignation of James O. Heyworth, manager of the wood ship division of the Emergency Fleet Corporation since the fall of 1917, was formally announced on January 19. As has been the case with most of the members resigning from the Board, Mr. Heyworth felt that he was needed in the operation of his private business in Chicago. A summary of the report issued at the time his resignation was accepted appears on another page of this issue.

Continuous Photo-Printing Machine

The illustrations on this page show a continuous photo-printing machine, used in conjunction with an automatic washing and drying machine, both of which were designed and constructed by the C. F. Pease Company, of 213-231 Institute Place, Chicago, Illinois, and

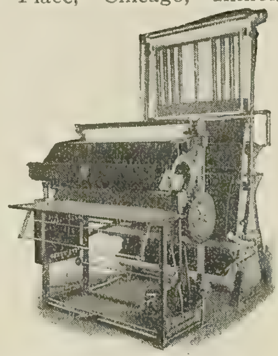


Fig. 1.—Peerless Blue Printing, Washing and Drying Equipment

are sold under the trade name "Peerless." With these machines a single operator can print, wash and dry 100 linear yards of blue prints per hour, during which time the apparatus consumes 7 units of electrical energy, 60 gallons of water and 50 cubic feet of gas. It is, of course, quite possible to use the machine for part of the time only, if such a large output is not required. The operator's time can then be occupied in other ways, and the working costs correspondingly reduced. Prints can also be made on separate sheets of sensitized paper, instead of in continuous rolls, if desired.

Fig. 1 is a front view of the machine and Fig. 2 is a side view, showing the course of the paper through the apparatus. The table from which the tracings are fed into the machine will be seen in Fig. 1, and beneath it are two horizontal spindles which carry rolls of sensitized paper of different widths. The tracings and paper are carried upwards over a cylindrical segment of thick plate-glass by means of an endless canvas belt, best seen in Fig. 2. Springs are provided to keep the belt tight, so as to ensure good contact, and side travel of the belt is prevented by a special device. The belt is driven by a small electric motor, the speed of which is controlled by a rheostat placed on the right-hand side of the machine; both motor and rheostat are clearly shown in Fig. 1. By means of the rheostat the speed of the paper can be varied from 4 inches per minute, which allows sufficient exposure for the slowest negatives and black-line prints up to 6 feet per minute. The exposed paper can be examined immediately after passing the glass segment, so that the speed can be adjusted to give the right exposure before any prints have been spoiled.

In front of the glass is a bank of five arc lamps of the enclosed type, fitted with aluminum reflectors. Each lamp is separately wired and controlled by switches, which are enclosed in a metal box on the left-hand side of the machine, as shown in Fig. 2. The number of lamps employed can thus be varied according to the width of paper being used. The motor switches are also enclosed in the same box, and all the wiring is encased in steel tubing. A small electric fan of the pedestal type is mounted on top of the switch-box. This fan, which can be distinguished in Fig. 2, drives a current of air in a transverse direction through the machine, in order to carry away the heat from the lamps. Fig. 3 shows how easily acces-

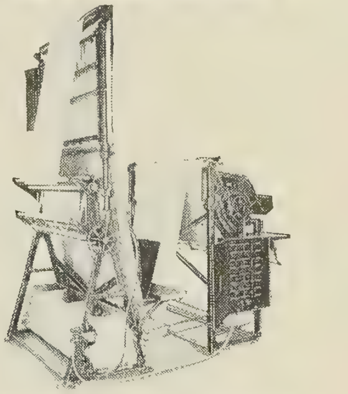


Fig. 2.—Showing Rolling-Up Device at Rear of Machine

sible the lamps are for trimming and cleaning, and also illustrates how they may be turned back to facilitate these operations.

After printing, the tracings are delivered into an enameled iron trough in front of the machine, so that the operator can remove them without changing his position. This trough, which can be seen in Fig. 1, also serves to catch the exposed sensitive paper, if the printing machine is used independently of the washing and drying equipment, as is often the case. Usually, however, the exposed paper is passed over a roller at the top of the printing machine, and thence to the washing and drying machine, as shown in Fig. 2. This part of the apparatus is driven, by means of chains and sprocket wheels, from the motor of the printing machine, and in it the paper is first washed by a spray of pure water and afterwards treated by a weak solution of potassium bichromate. This solution is contained in a galvanized tank placed in the base of the machine and clearly visible in Fig. 2. From this tank the solution is circulated by a small

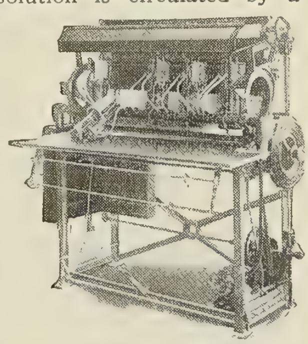


Fig. 3.—Peerless Blue Printing Machine

rotary pump, driven by an electric motor having a vertical shaft, and delivered onto the paper through a flexible pipe; an inspection of Fig. 2 will make the whole arrangement clear. After a further washing with pure water, the paper passes upwards in front of the drying device, over a roller at the top and down at the back of the machine. Here it passes through a system of rollers which carry a series of elastic bands,

running in opposite directions and forming part of a device for rolling up the finished prints. These are not wound up on a shaft, but the end of the paper, as it descends from the roller at the top of the machine, is formed into a loose roll, and this roll of finished prints, entirely free from wrinkles and distortion, being placed upon the bands, continues to roll itself up automatically until the operator wishes to cut it off and start a new roll.

PERSONALS

Commissioner Raymond B. Stevens, of the Shipping Board, who has represented the United States on the Allied Council since February, 1917, is reported to be returning to America.

William I. Donnelly recently inspected the 10,000-ton drydock being constructed by the Alabama Dry Dock Company for the United States Shipping Board at Mobile.

C. W. Cook, formerly acting head of the Shipping Board Division of Operations, has temporarily rejoined the organization to aid in the speedy charter of ships to private operators as they are released by the Shipping Board.

Lewis Nixon, vice-president of the Society of Naval Architects and Marine Engineers, and consulting engineer in New York City, has been appointed Superintendent of Public Works of New York State.

Eads Johnson, who has served as vice-president of the Carolina Shipbuilding Company while that company was being organized for work for the Shipping Board, has resigned to resume his practice, since the plans and specifications for which he was responsible are now completed.

J. C. Vaught, engineer for the American International Shipbuilding Corporation, United States Shipping Board, Emergency Fleet Corporation, has returned to Evansville, Ind., where he will be located with the International Steel & Iron Company.

H. L. Bekker, director of the Rotterdam Lloyd, who has been in New York several months, has returned to Rotterdam via San Francisco.

Mason G. Chase, naval architect, has been made a Knight in the Legion of Honor by the French Government for his service to France in her time of need.

Matthew C. Brush, president of the American International Shipbuilding Corporation, has taken up his duties as executive head of the Hog Island shipyard.

Christoffer Hannevig, the Norwegian shipbuilder and shipowner, has given $100,000 (£20,500) to lay the foundation of a national portrait gallery in the United States similar to that in England, the portraits to be of those men who have formed the driving force in America's efforts in the Great War.

Oscar R. Cauchois, American representative of French steamship lines in New York, has been made an officer in the Legion of Honor by the French Government in recognition of his service to France during the war.

W. Ruys has been appointed New York representative of the Rotterdam Lloyd and the Nederland Steamship Company.

Charles W. Schawb, former director general of the Emergency Fleet Corporation, has received the cross of Chevalier in the French Legion of Honor as a mark of recognition by the French Government for his tangible evidence of friendship toward France during the conflict.

Henry R. Robinson, expert on shipping, cargoes, rates and labor and wages, particularly on the California coast, has been summoned to France by Chairman Hurley. He will have charge of collecting data concerning conditions under which the American merchant marine will finally operate.

A. M. Avery, who has served as chief clerk to the district supervisor of the United States Shipping Board in the Southern District, from the earliest stages of the shipbuilding programme, has resigned to accept a position with the Terry Shipbuilding Corporation, Savannah.

P. J. Roosegaarde de Bisschop, director for the Java-China-Japan Line, is making investigations concerning Eastern shipping in San Francisco.

E. J. Griffith, who has had charge of the activities of the Emergency Fleet Corporation in obtaining crews for vessels in Northwest ports, has resigned to resume his position with the Pacific Steamship Company.

Walter A. Read, well known at the New York navy yard, has been appointed chief hull draftsman at the Fore River Shipbuilding Company.

P. L. Bjornsgaard has resigned his position in the drafting room of the Pusey & Jones Shipbuilding Company.

William Binley, Jr., formerly chief draftsman at the Fore River Shipbuilding Company, has been transferred to the central office of the Bethlehem Shipbuilding Corporation at South Behlehem Pa.

Allen Armitage has been made head of both hull and hull equipment drafting rooms at the Pusey & Jones Shipbuilding Company.

B. Williams, who for the past sixteen years has been with the Newport News Shipbuilding & Dry Dock Company in the hull drafting office, has been appointed president of the Phœbus Foundry Corporation, Phœbus, Va.

Capt. Charles Yates, New York manager of the Shipping Board's Division of Operations, has resigned from his position. He was the first official selected by the late Bernard Baker to assist in organization work.

Louis Luckenbach, with John A. Gregor, representative of the Bethlehem Steel Corporation, have sailed for Japan to establish a branch of the United States Shipping Board at Kobe, with the intention of building $100,000,000 (£20,500,000) worth of new ships at this port to be paid for by the United States.

T. Ashley Sparks, United States representative of the Cunard Steamship Company, and a director of the company since 1916, has sailed for Europe. Since May, 1918, Mr. Sparks has served as special representative of the British Ministry of Shipping.

A. F. Johnson, formerly marine superintendent, Army Transport Service, has taken a position as naval architect at the Fabricated Shipbuilding Corporation, Milwaukee, Wis.

OBITUARY

Capt. Emery Rice, commander of the steamship *Mongolia*, the first vessel to sink a German submarine, died at the New York Navy Yard Hospital on January 5, from influenza followed by pneumonia. Captain Rice has had an active sea record since before the beginning of the Spanish-American War.

Clement Acton Griscom, son of the late C. A. Griscom, founder of the Red Star and American Lines, and first president of the International Mercantile Marine, died at his home in New York, December 30, 1918. At the time of his death Mr. Griscom was president of the Griscom-Russel Company and the Audiffren Refrigerating Machine Company, as well as a director of the Empire Trust Company and other enterprises.

Alexander F. Bremmer, a marine engineer and owner of the Boston Engineering Company, died at his home in Wilton, N. H., on January 8.

Daniel Johanson, general manager of the National Independent Fisheries Company, and secretary-treasurer of the Nielson & Kelez Shipbuilding Company, Seattle, Wash., died on January 12 of influenza.

BUSINESS NOTES

Herbert W. Glehill, formerly sales engineer in the Philadelphia office of the Shepard Electric Crane & Hoist Company, Montour Falls, N. Y., has been made district manager of that office with Glenn Rumsey and Leland Woodworth as assistants.

N. L. Snow, formerly vice-president and sales manager of the Terry Steam Turbine Company, of Hartford, Conn., has been elected vice-president and general manager of that company.

I. H. Mills, who has been associated with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., for the past twenty-three years, has resigned to become superintendent of the Sperry Gyroscope Company, Brooklyn, N. Y.

Loyd C. Herring, formerly assistant district sales manager of the apparatus department of the General Electric Company in Boston, has become associated with L. W. Ferdinand & Company, Boston, Mass.

The American Pipe Bending Company, Boston, Mass., is about to open up pipe bending plants in all large cities throughout the country. Each plant will have facilities for turning out from 1,000 to 3,000 bends per day. Deliveries for small orders will be filled on forty-eight hours' notice.

The New York Belting & Packing Company are arranging for extensive additions and alterations to their plant at Passaic, N. J. Several modern reinforced concrete buildings are in the course of construction, consisting of two large manufacturing buildings, each five stories in height, a power house and an enlargement of the office building. By these additions greatly increased facilities will be provided for the manufacture of rubber belting for the transmission of power and for the conveying of ores and coal.

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Remove Shipbuilding Restrictions

NOW that the war emergency which caused the President to forbid American shipbuilders to accept contracts from foreign owners has ceased to exist, why should privately-owned shipyards still be subjected to arbitrary control and prevented from taking foreign contracts? As the weeks go by and no action is taken by the Government on this vital matter, shipbuilders are put in an embarrassing position. During the war millions of dollars were invested in new yards and in the extension of old yards, so that shipbuilding facilities in the United States to-day are vastly greater than in former peace times. In other words, the Government has induced most shipbuilders to increase their capacity enormously, and now it refuses them the privilege of bidding on work to fill up this capacity. In the meantime shipbuilders in other countries are taking orders for all the tonnage they can possibly build for a year or two in advance. A fair share of this business should go to American yards on account of their ability to give quick deliveries and by reason of the large number of men trained in ship work during the war period who are now available in the shipyards, but who will soon be dissipated into other lines of work if the yards are not kept working to capacity. Unless shipbuilding restrictions are promptly removed, the shipbuilding companies will suffer, not only financially, but more especially in the demoralization of their labor.

An Opinion From the Great Lakes

COMPLAINTS regarding the conditions outlined above do not come from the coast yards alone; shipbuilders on the Great Lakes feel the loss of opportunity to take business for foreign account just as keenly, if not more so, than shipbuilders on either the Atlantic or the Pacific. Commenting on the situation in a recent letter, M. E. Farr, president of the American Shipbuilding Company, Cleveland, states:

"It is unfortunate that the restrictions which prevent the building of ships for foreign account by American yards have not been removed long ago, as the embargo has allowed British yards to contract with neutral owners for a large amount of tonnage that would naturally come to this side. I do not believe as things now stand that we can compete with the British shipbuilder, but we have the advantage, particularly in the Great Lakes region, of making quick deliveries and we are also able to reduce costs within the range the neutral owner is willing to pay for early deliveries."

It must not be forgotten that vessel tonnage on the Great Lakes was one of the most important factors contributing to the victory in the war. Without the rapid movement of ore down the Lakes to the steel mills, at transportation costs, which are the lowest in the world, our part in the war would have been an entirely different story. While the withdrawal of lake tonnage to the seaboard has not seriously affected lake transportation, nevertheless during the war practically the entire shipbuilding facilities on the Great Lakes have been devoted to building sea-going vessels, and during that time existing yards have been greatly expanded, in some cases fourfold or more. To keep the big organizations which have been developed in efficient working order the shipyards on the Lakes should have every opportunity to take advantage of the business offered by the world's markets for shipping.

Second-Hand Vessels Not Wanted for the American Merchant Marine

WHILE no definite action has been taken by the Shipping Board in the negotiations for the purchase of vessels of the International Mercantile Marine flying the British flag, nevertheless this ghost still persists in haunting shipping circles. There is no doubt that British interests are anxious to dispose of these vessels and replace them with new and more efficient tonnage. That this is in line with the established policy of British shipping interests in maintaining the superiority of their merchant marine is shown by a report recently issued in England, which discusses the sale of "older vessels to foreign flags." This report states that "the transfer of large numbers of our older vessels to foreign flags was of great importance in connection with the development of our mercantile marine, and it cannot be overlooked in the consideration of future policy. It means that our shipowners were afforded a ready market for the disposal of vessels no longer satisfactory to them as a preliminary to the purchase of new vessels better suited to their purpose, and that the merchant tonnage of foreign countries as a whole was older and therefore less efficient than the tonnage of the British mercantile marine. It illustrates the process of growth which continually kept the British mercantile marine ahead of its rivals."

No one will question the soundness of Great Britain's policy in this respect, but, knowing the circumstances, why should we handicap our merchant fleet at the outset by acquiring a considerable number of vessels, which, with few exceptions, are old and inefficient and which will require enormous sums of money for their maintenance and operation, when we have at our disposal ample facilities and ability to build new and highly efficient vessels for our purposes? If the United States is ever going to compete in the transatlantic trade, it will be absolutely necessary for us to have the very best vessels that engineering ability can design and construct—not worn-out and second-hand tonnage which others are ready to discard.

Revision of the Shipbuilding Programme

THE suspension of orders for some 15 percent of the total tonnage contemplated by the Shipping Board is explained by Director General Piez, of the Emergency Fleet Corporation, in a reassuring statement as a necessary step in making a complete revision of its entire shipbuilding programme. During the war the Fleet Corporation built all the vessels it could and selected types, not because they might ultimately prove the most useful, but because they could be readily and quickly built in existing yards. Too many vessels of small tonnage were constructed and not enough of large tonnage and greater sea speed. To rectify these mistakes and at the same time to determine a new policy it has been decided to suspend work on all vessels the progress of which justifies the assumption that they can either be cancelled or have other vessels substituted for them with the minimum of expense. The suspension of orders will not cause any appreciable slowing down of the operations in any of the yards for six months or more. Even with such suspensions as are contemplated, there will remain volume enough in most yards to keep them busy under normal speed for from 12 to 18 months. In the meantime investigations will be made to determine the character of vessels that will prove profitable additions to the merchant fleet, and to decide the question whether, under the appropriations thus far made and the authority granted, they are justified in substituting new types of vessels for those suspended.

Efficiency of Reciprocating Engine

IN any attempt to improve the efficiency of marine reciprocating engines it is hardly likely that any fundamental changes will occur, but attention to details is often instrumental in bringing about a considerable economy in operation. One of the most important details and one which is worthy of the closest attention of designers is the arrangement of steam ports. With a view to reducing the clearance volume to a minimum, short, straight, steam ports at the ends of the cylinder can be employed in conjunction with a long valve, this having the additional advantage of reducing the internal surface which is cooled by the passage of the exhaust steam, and upon which the incoming steam will condense. Again, the cylinder covers should join the cylinder as near the face of the cover as possible, and the surface of cylinder cover should be kept as small as possible; in this way, while the clearance volume may be unaffected, the internal surface upon which steam may condense is again reduced to a minimum.

Developing the Port

NEW YORK is a trading city—or it is a ruin. Geography has done everything for it; until now its government has lagged behind private enterprise in modernizing its pier facilities.

Dock Commissioner Murray Hulbert, Director of the Port, has prepared a full programme of development that deserves the sympathetic study of the Board of Estimate. He plans the straightening of the Harlem River, the construction of new ship canals to link Flushing, Gravesend and Jamaica Bays with the Barge Canal, the use of ashes to fill bulkhead land instead of the costly waste of them at sea, the saving of 18,000 miles of navigation yearly by placing the Sound steamers in the East River, better economy in the use of railroad piers, the removal of Shell Reef, and the construction of new piers which can be rented on a 7½-percent basis.

Some of this plan is the proper work of the Federal Government. But for the most part these development projects are up to New York city—to the city alone, but as trustee of the nation's commerce, as the war has shown. If the whole of the $100,000,000 needed for dock development is not available immediately, we can at least make a beginning and let no year pass without some substantial progress.

Rivetless Ships

THE welding together of structural parts of ships has, until lately, been objected to on the ground that internal stresses are thereby set up in the material about the surfaces of contact and that the parts thus maltreated cannot be annealed. Further experience with such welding, however, is now considered to have shown that, with proper methods of work, the internal stresses are less formidable than was supposed, and new annealing processes also have been matured.

Let us assume the internal stresses difficulty partly eliminated. The section of the longitudinal girder of a riveted ship is reduced by rivet holes to the extent of about 12 to 14 percent in way of a frame and, practically, by about 16 to 19 percent, a little distance from the frames in way of buttstraps. With ordinary methods of buttstrapping, its resistance to longitudinal bending is reduced by probably more than 25 percent. Admitting that this loss may, by expensive kinds of strapping, be partly made good, we still have perforations of some 20 percent, to set against the supposed weaknesses of the welded connections. But the riveted structures are also heavier by some 8 to 10 percent in straps, and 1½ to 2 percent in rivet heads—say 10 percent in all—than the rivetless ones. Assuming the welded plates made one-tenth inch thicker, so that the structures were equal in weight, we should have an excess, not of 20, but of 30 percent available section of material in the rivetless structure to set against assumed weaknesses in the vicinity of the welds.

The foregoing rough estimate has been based on loss of section in plating due to rivet holes, but the plates in a riveted structure are also very unevenly stressed. A butt connection is practically a spring, and has been found, by careful laboratory experiments made on strakes containing butt-connections, to extend much quicker than the solid material between the butts. This means that in a seaway the points of strake plates just above and just below ordinary end-connections in a strake have to take an undue share of the total work. Since the most heavily stressed points of a structure are the first to give out, this represents a lowering of its capacity for work. A further percentage of an unknown, but not very small amount, must therefore be added to the 30 percent above arrived at.

Experience will soon show the strength or weakness of the rivetless ship, but the experiment is one that deserves to succeed, and it may well result in large savings of weight and of labor. Methods of welding and of annealing will no doubt be still further developed. Provided their past defects can be overcome and processes of application can be sufficiently simplified and cheapened, their application will remove difficulties of many kinds in ship construction. Corner-bar connections will be stronger and more easily made. Girders that cross each other at right angles will become "continuous" in both di-

rections. Watertightness will be attainable in the most difficult places, and the comparison of lines of riveting with stamp-perforations made to "facilitate tearing assunder" will cease to apply.

The Steering of Ships

ALL ships must possess the power to maneuver, but exactly to what extent will depend on the type of the vessel and the use for which it is intended. Although all vessels possess the power to maneuver, it can hardly be said that the majority of ships are really easy to handle. It is true they are handled, and handled effectively, but nevertheless captains often wish that they had more control over their vessels than is given them, even by twin screws and the ordinary rudder.

It will not be without interest to examine what takes place when helm is given to a ship. As the rudder at first goes over, the ship for the moment continues on her course and there is a sudden concentration of water between the rudder and the deadwood aft. This sets up an increase of pressure on both the rudder and the deadwood, which pushes away the stern of the ship in the opposite direction to which the rudder is turning. The ship also moves bodily outwards. The instantaneous effect, therefore, is to move the ship along a course, which is curved in the opposite way to that in which the ship is required to turn finally. In a short time the ship takes up a definite but not really steady swing. This swing is helped by the pressure on the bow, the excess pressure on the deadwood aft being reduced. Shortly after this, the vessel settles down to a steady swing, the pressures on the bow and the rudder turning her, but the pressure on the deadwood aft is now on the opposite side to what it was originally, with the result that it retards the turning of the vessel. Equilibrium must eventually be established when the center line of the ship takes up a definite angle to the direction in which the center of gravity of the ship is traveling. This angle is called the drift angle. The distance between the original course of the vessel and the position of the ship when she is moving in exactly the opposite direction to her original one is called the tactical diameter of the vessel. If this is to be small, the deadwood aft should be well cut away.

When the ship settles down on her turning circle, about the center of which she rotates, there is some point—usually well forward of amidships—on the vessel which only has a motion along the center line, every other point on the vessel really moving in some other direction. This point is called the pivoting point, and the resistance of the various parts under water to turning depends on their distances from this pivoting point. Since the pivoting point is forward of amidships, it follows that the aft deadwood is more effective in reducing turning than the forward deadwood.

When the rudder is first put over, the center of pressure on it is below the center of pressure of the force opposing the lateral motion of the ship and in consequence the vessel at first heels towards the center of the turning circle. When steady motion is established, centrifugal force acts on the vessel through a point generally above the waterline and certainly above the center of lateral resistance. This force is more powerful than the pressure on the rudder, with the result that the vessel heels outwards. Although this is very generally true, it would be possible to conceive of a case where the pressure on the rudder was so great and relatively high, and the center of gravity of the ship, through which the centrifugal force acts, so low, that the ship might heel inwards on the turning circle instead of outwards.

It is, of course, well known that wind will affect the steering of a ship. If she is moving with the wind on the beam, the center of pressure of the wind force on the above-water portion may be forward or abaft the center of lateral resistance of the under-water portion. In any case, helm will have to be carried one way or another to correct the tendency of the wind to turn the ship. This will always decrease the speed of the vessel. In one particular case, it so happened that the center of pressure of wind was abaft the center of lateral resistance, the deadwood aft was cut away, bringing the latter point further forward, making matters worse, so that a good deal of helm had to be carried with a beam wind.

It is generally understood that wind can affect the speed of a ship a good deal. If the wind is directly ahead, it will retard the motion of a ship considerably by direct pressure, although it will not affect the helm. If it is on either bow, it will not only retard the speed on account of its direct pressure, but also by the fact that helm will have to be carried to keep the vessel straight. With wind directly on the beam, helm will always practically be carried, and the speed of the ship will be retarded on this account, although the wind pressure has no direct effect.

Rudders are divided into several classes. The most common form is the ordinary merchant ship rudder, in which the whole area of the rudder is abaft the axis of rotation. For many years the most common type of rudder in war vessels has been the balanced rudder. This takes several different forms. It may be completely balanced and supported by the rudder head and a bottom pintle, or it may be completely balanced and also completely underhung and supported from two points on the rudder stock. There is another form of rudder, described as semi-balanced, in which a small portion only of the rudder area is forward of the axis, the rudder being pivoted on the rudderhead and one or more pintles, the portion of the rudder below the bottom pintle being completely underhung.

The ordinary merchant ship form of rudder remains in general use because it is easily handled, although it is not so economical in form as some of the other types; speeds of merchant vessels being generally small, does not make the rudder unmanageable in size. The steering gear for it has to be larger and heavier than the more effective rudder of the balanced or semi-balanced type; all of its area being abaft the axis, the twisting forces acting on it are much greater than with the latter types. For vessels with cruiser sterns—which includes practically all war vessels—the balanced type of rudder becomes almost a necessity, although in the last few years certain merchant vessels fitted with cruiser sterns have still been given the ordinary merchant type of rudder, and it is doubtful if there is any reason to depart from this form in general practice. If particularly rapid maneuvering is required, there may be some reason for it.

There is no very accurate way of working up the strength of rudders from first principles, as the forces acting on them have never been very accurately determined. Formulæ are used for this purpose in certain cases which are admittedly comparative. For the majority of merchant vessels the necessary rudder sizes are all given in the rules of the Registration Societies. It can hardly be said that a rudder is particularly effective in controlling a ship; in fact, if specially delicate maneuvering is required in a vessel, twin screws must always be fitted to assist the rudder. Whether more effective methods will be devised for controlling the motion of a ship must be left for the future to decide, but any improvement on the present system would certainly be sure of a warm welcome.

LETTERS TO THE EDITOR

Systems of Ship Camouflage

The article entitled "Principles Underlying Ship Camouflage" in the February issue speaks with authority and accuracy in so far as it applies to the later development of this subject and the application of the English dazzle system. As it refers to the earlier stages of the art, however, it is extremely inaccurate, and should be corrected.

In the first paragraph, it states that prior to January, 1918, there were five systems in use. At the close of the article it states that after March 1, 1918, the British dazzle system was put into effect by the United States Shipping Board. As a matter of fact, the order requiring the use of the British dazzle system was not issued until May 9, to go into effect on May 20, 1918.

In September, 1917, the protective committee of the United States Shipping Board issued an order, to become effective on October 1, requiring that all ships sailing for the war zone should be camouflaged by one of four systems. These were the Toch, Mackay, Brush and Herzog systems. The Warner system was not developed or approved until lately. In fact, as far as the writer knows, the order of December 9 was the first order recognizing this as one of the approved systems. Mr. Herzog did not evince much interest in the matter, so that the three systems most extensively used were those of Toch, Mackay and Brush, and they were used from October 1, 1917, until May 20, 1918.

Mr. Bement says of these systems that they "were all of the low visibility type; and though in some cases color, and in others black and white were used, it was all for the same purpose, to produce grey at a distance." As this applies to the Toch system, it is absolutely inaccurate. Dr. Maximilian Toch was the first man in America to advance the idea of the disruption and contortion of form by the breaking of the lines with large blotching and contrasting colors.

In May, 1917, a full year prior to the use of camouflage by the Shipping Board, the writer, under the direction of Mr. Toch, camouflage-painted for the Navy Department, the two coast stations at Key West and Pensacola. Three colors were used, a very light gray, a very dark gray, and a dark green. The scheme used throughout was to break up the buildings in large blotches of contrasting colors. This is absolutely a matter of record in the Navy Department and not open to question.

Mr. Toch was one of the first to suggest to the Shipping Board the use of camouflage on ships, and it was due to the previously mentioned work in this line that the system was specified by the Shipping Board. As applied to the ships, the same idea was used. Large blotches of more or less "S" shape were carried diagonally across the hull from the waterline to the deck line, and four colors were used—a light gray, a light pink, a dark gray and a dark green. The bow wave referred to by Mr. Bement was always used, while the false bow was painted on many ships in light colors.

The Toch system varied in one important feature from the British dazzle idea, as originally presented. It was believed that two conditions existed: First, the discovery of the ship at long distance, and second, the shooting at it from a shorter distance. With this idea in view, the superstructure was always painted in very light colors, though the blotch was still maintained to some extent. The dazzle effect was merely applied to the hull, but colors were used which were of low visibility value at long distances, though contrasting strongly at the shorter distances.

The British dazzle system entirely ignored the question of visibility and depended entirely, as stated, on the contortion effect. It is a fact, too, that of the forty odd ships painted in the Toch system but one was lost, and this at a time when the paint had become ineffective through the making of several trips without repainting.

As regards the Brush system, the writer can only speak from observations, but certainly it was not, as stated by Mr. Bement, a black and white system. The colors used, as far as observation could determine, were a medium gray, a very light gray or white. The idea seemed to be merely to paint out all shadows on the boat with the light color and thus destroy their darkening effect, which, of course, increases visibility.

New York. A. R. Rhett.

High Development of Structural Materials an Important Factor in American Shipbuilding

The spectacular development of shipbuilding within the last three or four years has had at its base the advantage of structural materials which represented the best results of scientific research in their respective fields. The problem of material and machinery has been, to a large extent, solved by the demands of our regular industries calling for higher and still higher standards of accuracy, durability, etc. Nowadays, material is selected for its usefulness and durability. For example, where an easily damaged pipe of lead was used because wrought pipe would have been difficult to bend to the desired shape, or no convenient facilities for galvanizing were at hand, the difficulty has been removed by the fact that it is now possible to obtain modern wrought pipe that for all practical purposes may be bent to the same radii as lead pipe, without opening in the weld or in the wall, and facilities are provided for galvanizing such parts after bending, either in the yard where a ship is constructed or in an outside shop specializing in such work. Modern pipe, as a matter of fact, has reached as high a state of development (if not higher) as any of the other materials entering into the making of a ship. One manufacturer of pipe gives the pipe special mechanical treatment in manufacture to minimize any tendency to corrosion; the process used is called "Spellerizing," and is given to the smaller sizes of pipe (4-inch diameter and under), because of the relatively thinner walls of pipe of these sizes. This is but one of many beneficial results of scientific research employed in developing wrought tubular products.

Similar efforts and constructive thought have characterized other industries whose products enter into the construction of a modern ship. Steel plates, bars, shapes, etc., are typical of high development, both in a metallurgical sense and in the more obvious sense of accuracy, the wide variety of special shapes obtainable and the general service rendered by the organizations and facilities which produced them. The progress in the development of basic materials, which has occupied a considerable period prior to the sudden development of shipbuilding subsequent to 1915, exercised an accumulated force which relieved the minds of naval architects, engineers and executives of many problems, and has helped, as a consequence, to enable shipbuilders to turn out a durable, seaworthy vessel of 8,000 tons in the short space of a month or two.

Pittsburgh, Pa. E. E. Keller.

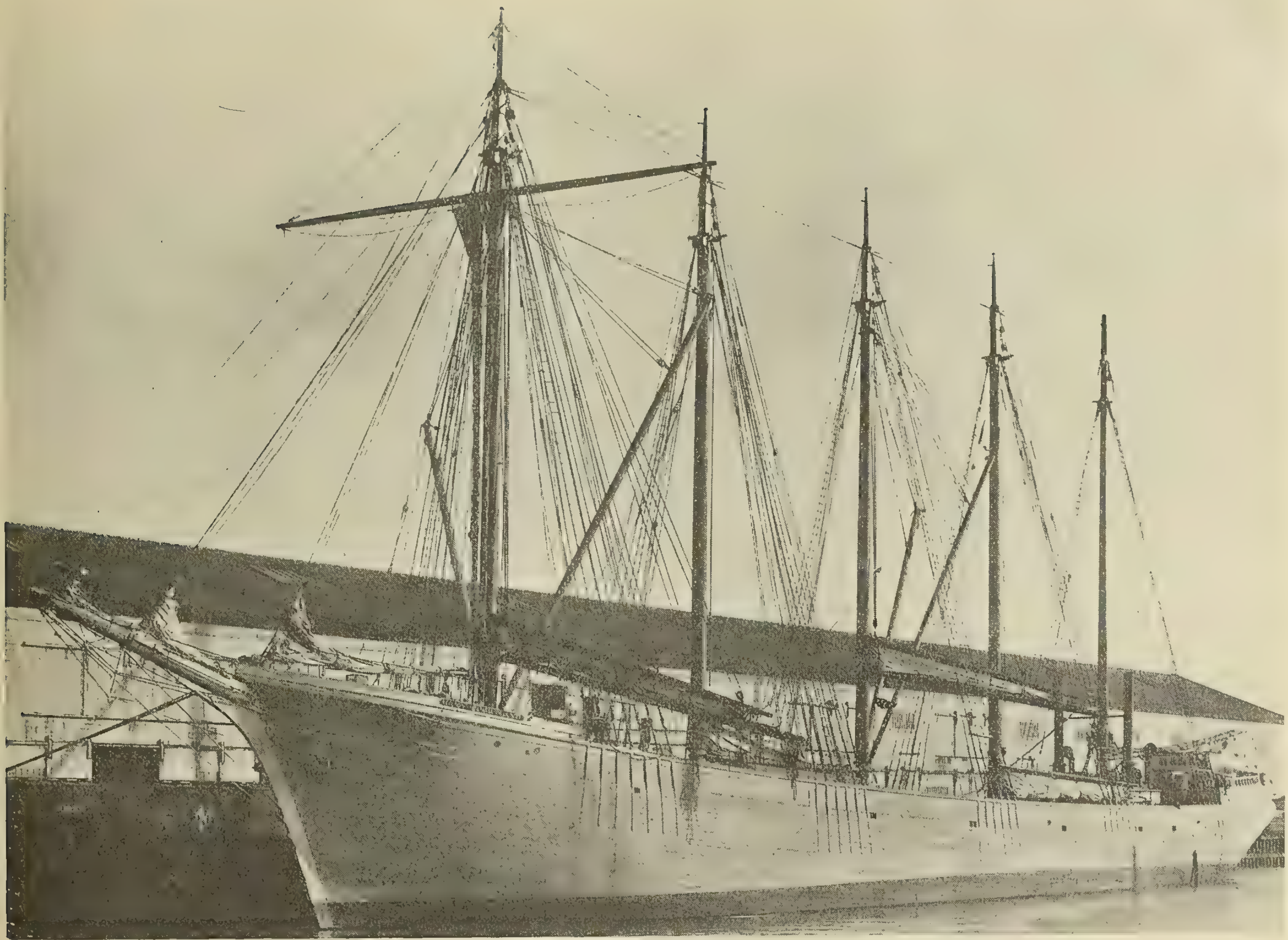


Fig. 1.—Motorship *City of Portland* of the McCormick Steamship Company

Economical Motorships on the Pacific

Records Made by New and Converted Motorships Fitted With Bolinder Oil Engines—Comparison With Steamships—Fuel Savings

BY CHARLES W. GEIGER

THE recent announcement of the McCormick Steamship Company of the saving made by the adoption of the internal combustion engine in the *City of Portland,* amounting to more than 50 percent over that of a steamer of similar size and draft, is calling a great amount of attention to this type of vessel. This announcement was made following the arrival of the motorship at Shanghai after a thirty-five days' voyage via Honolulu from San Francisco, a distance of 6,000 miles.

Cost of Operation

The cost of fuel oil to the motorship was $40 (8/6/8) a day. The cheapest cost of operation for steamers burning oil is $99 (20/12/6) per day. The *City of Portland* saved about $15 (3/2/6) in firemen's wages and about 20 percent of her cargo space that would have been needed for coal. She carried lumber, on which the rates reached a total of $97,000 (£20,000), whereas if a steamer she could have carried a cargo earning only $80,000 (£16,-400). In resumé, the officials estimate that, if normal rates appertained in this cargo, a steamer could have broken even on the voyage and the motorship have earned $20,150 (£4,125).

The *City of Portland* has not been tied up for repairs for a year and a half, and recently made the run from San Francisco to the mouth of the Columbia River in three and a half days, despite unfavorable weather conditions. The vessel has the following dimensions: length 276 feet, breadth 48 feet, depth 21 feet, approximate deadweight tonnage 3,500. She is equipped with twin 320-brake horsepower Bolinder engines, type "M-11" and has a lumber carrying capacity of over 2,000,000 feet.

Motor Oil Tankers

Following the unusual demonstration of the *City of Portland,* the Philippine Vegetable Oil Company is placing a fleet of oil tankers in operation between San Francisco and the Orient, all of which will be operated by the Bolinder type of internal combustion engine. The first of this fleet of oil tankers, the *Nuuanu,* has recently completed her second round trip between San Francisco and the Orient, carrying out a cargo of petroleum oil and returning with a cargo of cocoanut oil from Manila. The *Nuuanu* was equipped with a 320-brake horsepower "M-11" Bolinder engine in 1916. Previous to this installation

she had been towed from port to port. The *Nuuanu* is 211 feet in length, 34 feet in breadth and 19 feet 6 inches in depth. She was originally an iron sailing vessel, but was converted to an oil tanker by the General Petroleum Company, from whom she was purchased by the Philippine Vegetable Oil Company.

The Philippine Oil Company has recently purchased a second vessel, which is being converted into an oil tanker, and is being powered with a pair of 320-brake horsepower Bolinder engines. Two additional vessels, each equipped with a pair of 500-brake horsepower Bolinders, will soon be placed in operation by the same company in transporting petroleum oil to the Orient, returning with cocoanut oil.

First Bolinder-Engine Vessel on the Pacific

The first vessel on the Pacific coast to be equipped with a Bolinder engine was the motor tug *Marie L. Hanlon*, owned by the Hanlon Shipbuilding Company, of Oakland. This engine is of 160-brake horsepower and gives the tug a speed of 9¾ knots. It has been in continuous operation since being installed, the tug being engaged continuously day and night towing barges with most satisfactory results.

The engine installed in the *Marie L. Hanlon* was the experimental and testing engine that had been brought to San Francisco in August, 1913, for experimenting with different qualities of California asphaltum fuel oils. Having quickly found quite suitable California fuel oil, very satisfactory and convincing trials were conducted by the factory engineer, proving conclusively that internal combustion engines of the Bolinder type could be operated in a practical and dependable manner with various California asphaltum base fuel oils of the inexpensive varieties. Since then, large mineral oil companies, such as the Standard Oil Company of California and the Union Oil Company of California, have marketed a product known commercially as "Colol" and "Diesol," respectively, of about 24 degrees gravity, which is giving excellent results and with which the Bolinder engine has since been operated without any apparent deleterious results over a period of several years.

Fig. 2.—Philippine Vegetable Oil Tanker *Nuuanu*

Fuel Oil Supplies

Supplies of fuel oil suitable for internal combustion engines of the Bolinder type are now held in storage by the Standard Oil Company of California at all principal coast ports and the Hawaiian Islands. Elsewhere oil companies in ordinary times have supplies on hand of good oil. The refueling of Bolinder boats fitted with sufficient tankage is exceptional, as most of the wooden boats have fuel capacity sufficient for a round voyage or up to about 12,000 nautical miles. In steel hulls the double bottom and water ballast tanks supply more than ample storage for fuel oil.

Serious consideration has been given to the proper installation of the engines, and from the experiences gained on the various boats and minor improvements made in the completed installation, the chances of mishaps and breakdowns have been so minimized that no serious trouble has arisen under present conditions as has been shown by an examination of engineers' logs on various boats. Numerous instances of non-stop runs of 30 to 40 days have been shown by the engineers' logs.

Long Non-Stop Runs of Motorships

As a proof of the ability of motorships to make long trips without replenishing the supply of fuel oil, the full powered motorship *Sierra*, owned by the E. K. Wood Lumber Company, might be mentioned, which, since being in commission, has made numerous voyages between Astoria and San Pedro, and other complete voyages to the Western Coast of South America, taking lumber cargoes as far south as Valparaiso and returning with cargoes of nitrate. This vessel is 210 feet in length, 15 feet in depth and 42 feet beam, with a deadweight tonnage of 1,875. The engine-room equipment consists of twin 320-brake horsepower Bolinder engines, with one 8 and one 15-horsepower stationary engine for electric lighting and general purposes.

On account of the low consumption of fuel oil, the *Sierra* was able to make the voyage to any of the South American ports and return without having to deviate from her course to call at ports for the purpose of replenishing the supply of oil at exorbitant rates, which has to be done in the case of steamships.

Four Motorships of the Grace Company

A considerable amount of interest is centered in the four motorships that have been placed in commission by Messrs. W. R. Grace & Company. They are the *Santa Elena, Santa Isabel, Santa Cristina* and the *Santa Flavia*.

The propelling machinery of these vessels consists of two 320-brake horsepower Bolinder oil engines, fitted with air injection and an improved oiling system, which has resulted in considerably reducing the consumption of lubricating oil. The machinery is located in a large engine room amidships, which has a most pleasing and roomy appearance, the engines being firmly secured on strong cast iron foundations.

The auxiliary machinery consists of one 15-brake horsepower Bolinder engine, direct connected to a 10-kilowatt generator, and one

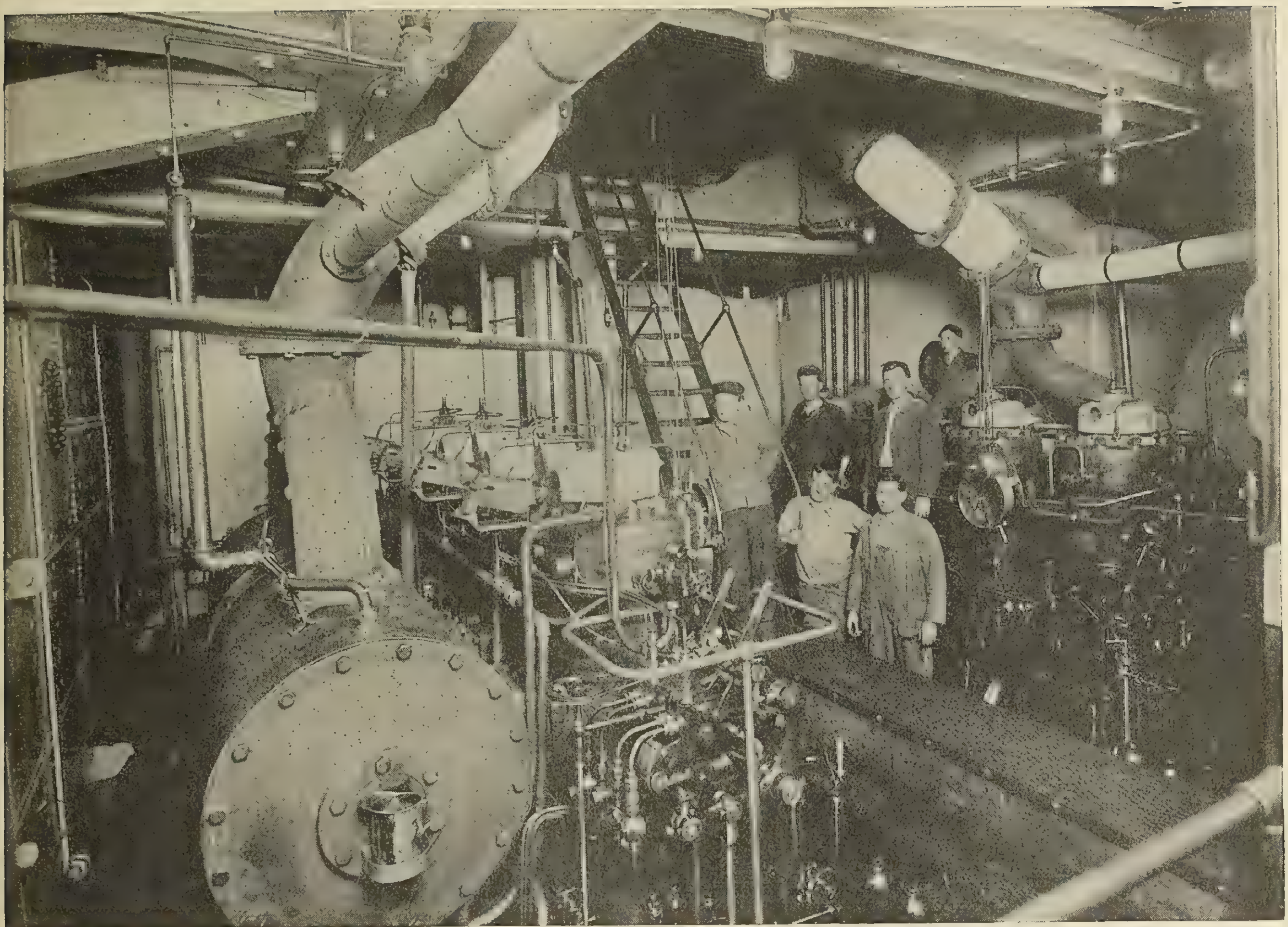


Fig. 3.—Engine Room of Motorship *Sierra*

rotary pump of 2,500 gallons' capacity, and one 8-horsepower Bolinder engine connected to a 5-kilowatt generator and rotary air compressor. The refrigerating plant consists of one 1-ton Brunswick motor-driven ice machine, the ship being fitted with 600 feet of refrigerating space for ships' stores.

The main fuel supply is carried in four steel tanks just forward of the engine room with a total capacity of 1,320 barrels, and these, together with four steel tanks having a combined capacity of 412 barrels, and two 20-barrel day tanks in the engine room, give a total capacity of 1,770 barrels, or sufficient for nearly 80 days' running.

Moderate-Sized Motorships More Economical Than Steamers

These ships are excellent examples of the possibility of moderate-sized vessels equipped with fuel-oil engines. The extensive radius over which they are able to travel without having to stop for refueling, combined with their fuel economy, give them an immense advantage over the ordinary steamer, to which may be added the increased cargo space obtained by the elimination of steam boilers.

These four ships were carefully designed and built with all the conveniences of a large modern liner. The dimensions of the *Santa Elena* and *Santa Isabel* are: length 225 feet, breadth 42 feet, depth 29 feet, cargo capacity about 2,000 tons on 18-foot 6-inch draft. The *Santa Cristina* and the *Santa Flavia* are 235 feet longer than the two first named vessels, all other dimensions being about the same.

Auxiliary Motorships Making Good Records

The two auxiliary motorships, *La Merced* and *Oronite*, are of very fine models and are making some very fast passages. These vessels are operated by the Standard Oil Company. Each of the vessels is equipped with two 160-brake horsepower Bolinder engines. The *La Merced* completed a trip to Melbourne and return, carrying case oil on the outward voyage and returning with a cargo of grain, the outward voyage being made in the good time of 48 days, and the return voyage in 53 days. The distance by steamer route to Melbourne is 6,966 miles, so that the time occupied in making the voyage out in 48 days for a vessel of such moderate power must be considered excellent. The return voyage, which was made by the route south of the Islands of New Zealand, covered a distance of nearly 8,000 miles, and the time, 53 days, must be considered extremely creditable.

The first vessels on the Pacific Coast to be equipped with Bolinder engines as auxiliary power were the steel sailing barks, *Annie Johnson* and *R. P. Rithet*, owned by the Matson Navigation Company and engaged in the San Francisco and Hawaiian trade. These vessels, which are approximately the same size, having a capacity of about 1,800 tons cargo, had installed in them two 160-brake horsepower engines. They had been in service about 30 years at the time this installation was made in 1916, and had been in the Hawaiian trade for nearly 8 years, averaging about six round trips per year, while propelled by sail power alone. These voyages cover the time taken up in making various calls to the different ports

in the Hawaiian Islands, the ships being towed from port to port.

EARNING CAPACITY OF VESSELS INCREASED 50 PERCENT

Since the installation of auxiliary power, the above ships are now able to make about nine round voyages per year, showing a gain of nearly 50 percent in the earning capacity, and of course they are able to make the trips between the different island ports under their own power, saving a considerable amount in towage expenses. The average time consumed in making the voyage between San Francisco and the Hawaiian Islands is about twelve and one-half days.

The auxiliary motorship *R. P. Rithet*, after having been in commission for about one year, was destroyed by fire. Since the installation of the power machinery in the *Annie Johnson*, the cost of repairs to her machinery has not exceeded that of a similar steam plant.

FUEL AND LURBICATING OIL CONSUMPTION

On a voyage between San Francisco and Honolulu to Mahukona and return to San Francisco, the following amount of fuel and lubricating oil was used by the *Annie Johnson*. Total running time of engines 29 days, total consumption of fuel oil 289 barrels, total lubricating oil used 400 gallons, approximate total cost of fuel and lubricating oil for the round trip $550 (£113).

The motorship *Ozmo*, formerly the three-masted schooner *Hugh Hogan*, was built in 1904. In 1916 the owners decided to convert her into an auxiliary motorship and at the same time reconstruct the vessel, adding a shelter deck, which has considerably increased her cargo capacity.

The power installation consists of two 160-brake horsepower Bolinder engines driving twin screws. This is the equivalent of approximately 450 indicated horsepower and is sufficient to maintain a speed of 8 knots with the ship fully loaded.

The *Ozmo* has a length of 160 feet, depth 9 feet 8 inches, beam, 38 feet 8 inches. One of the best records made by this vessel was a voyage to Wellington, N. Z., from San Francisco in 39 days and returning in 45 days.

ADVANTAGES OF OIL ENGINES OVER STEAM

The advantages of the internal combustion engine over steam, even when fitted with fuel-oil burning apparatus, are very marked, and in some instances the cost of the engines has been saved within a period of 24 months. Other advantages are as follows:

1. Cargo space saved (eliminating boilers, fresh water, and one-half to two-thirds bunker space of fuel-oil tankage).

2. Smaller engine-room force (stokers or firemen eliminated).

3. Eliminating the necessity of calling for fuel, saving extra port charges, delays and extra cost of fuel and water at out-of-the-way ports.

4. Fuel consumption about one-third of boiler consumption.

5. Fresh water not required for main engines.

6. "Raising steam" and standby costs eliminated.

7. Lower repair bills, no boilers to clean or constant repair to same, furnaces, floor plates, etc.

Taking it for granted that merchant ships and steamers are operated for the purpose of profit or carrying cargo at a minimum cost, the hull that can carry the most cargo at the lowest cost at the usual tramp speed at about an equal outlay of capital is the most economical. Trans-Pacific trade is the one that the Pacific coast is most seriously interested in. Developing and extending the export and import business with the Orient, Australia, South America and the Pacific South Sea Islands should be the endeavor of all Pacific coast merchants and shipping companies, and to handle overseas goods and products, tonnage is absolutely necessary. On account of the distances, difficulty has been experienced in finding economical ships; an ordinary tramp of 5,000 tons deadweight, inclusive of bunkers, on the same voyages, can carry only 3,000 to 4,000 tons of actual freight-paying cargo on account of the space taken up by bunkers or weight of fuel oil.

Charts for Use in the Design of Propelling Machinery for Usual Type of Cargo Ships

Curves Compiled for Finding the Horsepower, Boiler Surface, Condenser Surface and Quantity of Cooling Water Required

BY JAMES L. HAYNES, M. E.

THE following set of charts is compiled for the use of engineers who are handling designs of power plants for the usual type of cargo ships. Many inconsistencies are met in comparing sizes of boilers, engines and condensers for various arrangements of machinery in use, and as engineers base much of their work on existing designs they have to estimate many factors basing opinions on conflicting precedent. These curves have been worked out to facilitate the determination of consistent results, considering as many primary variables as it seemed practicable to include and assuming fixed all factors that are likely to be nearly the same on all ships in the class considered.

For any new ship, it is assumed that the displacement, speed, type of main engine, type of boilers, kind of fuel and rate of firing are known. With this much information we are able to decide the horsepower, boiler surface, condenser surface and quantity of cooling water quite accurately from the charts; and, having found this information, the other auxiliary machinery depending on these sizes is easily calculated.

The chart shown in Fig. 1 is based on the formula given by Rear Admiral C. W. Dyson, U. S. N., in his book on propellers, with constants supplied to suit our work.

$$\text{Shaft horsepower} = \frac{D^{2/3} V^3 \times .92}{230},$$

where

D = tons displacement.
V = speed in knots.

The Admiralty coefficient 230 has been chosen as applying to the cargo ships we are to deal with, which have a block coefficient of about .78.

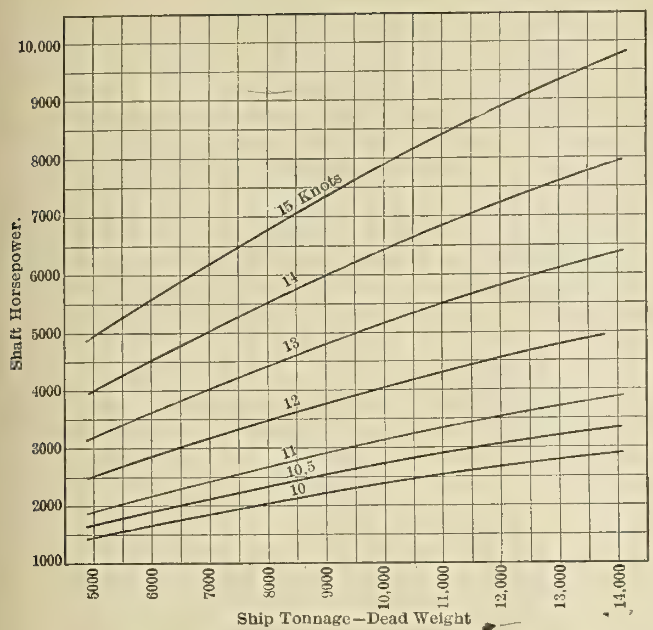


Fig. 1.—Power-Speed Curves Standard Cargo Ship. Block Coefficient 0.78

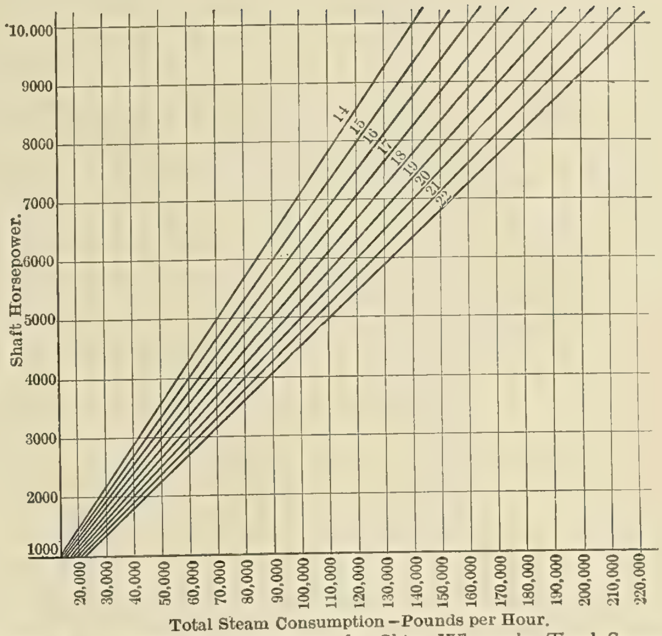


Fig. 2.—Total Steam Consumption for Ships Where the Total Steam Per Shaft Horsepower is Known. For Class of Ships Considered it Varies from 14 to 22

With this chart it is easy to pick off the power for ships included within its range, when the tonnage and speed are given.

The number, sizes and styles of the auxiliaries, as well as the type of main engine or turbine, will guide in deciding what to allow for total steam consumption per shaft horsepower for the ship. This will probably fall between 14 and 22 pounds, and the chart shown in Fig. 2 gives the total steam per hour by reading down from the intersection of the line for shaft horsepower and the proper rate of consumption. There seems to be no way of fixing the rate of steam consumption except by comparison with trials of similar ships.

If the boilers are to be coal fired, we next use the chart shown in Fig. 3. This chart is taken from Dr. Charles Edward Lucke's "Engineering Thermodynamics," and shows the relation between draft and rate of burning different kinds of coal. By reading across from the proper amount of draft to be used to the curve for the kind of coal used and then down to the horizontal line representing the ratio of heating to grate surface, we obtain the reading of pounds of coal per square foot of heating surface per hour.

With this value from Fig. 3 we use the chart shown in Fig. 4, taken from Dr. Lucke's "Thermodynamics," to determine the rate of evaporation for the boiler. The method is evident. Read up from the proper value for pounds of coal per square foot of heating surface per

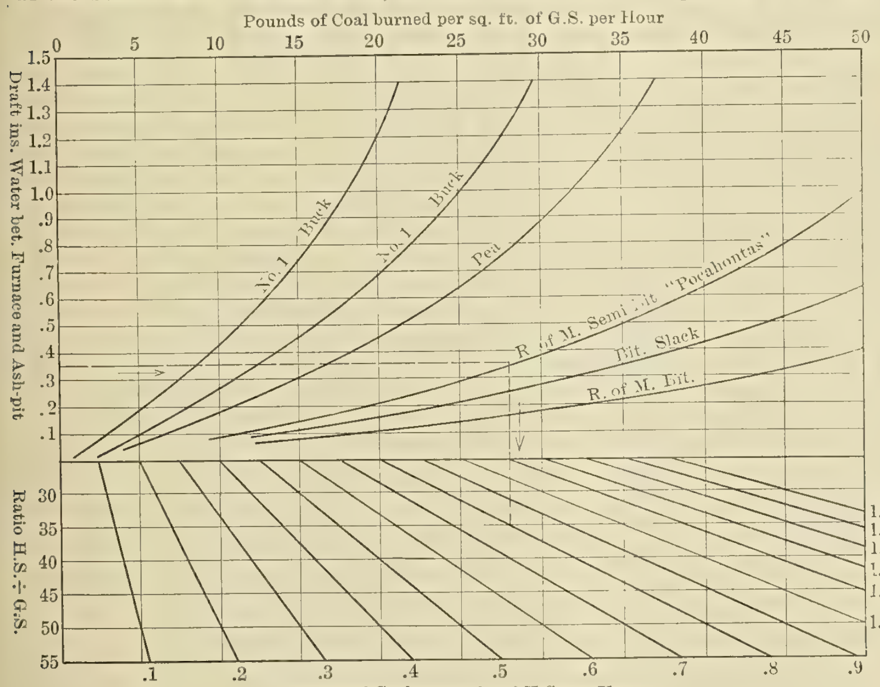


Fig. 3.—Relation Between Rate of Combustion and Required Heating and Grate Surface for Different Boilers and Coals. Boiler Efficiencies Assumed to Be Equal

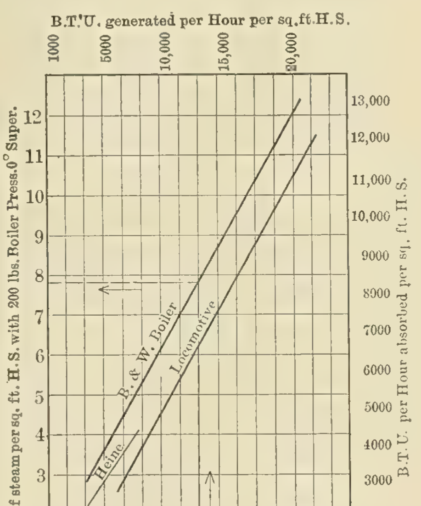


Fig. 4.—Relation Between Rate of Combustion and Capacity, Navy Boilers, Arranged for Reading Pounds of Water Evaporated Per Square Foot of Heating Surface Per Hour With 160 Degrees of Feed Water. Curve is Average of Several Boilers with Pocahontas Coal

hour, as found by Fig. 3, to the proper boiler curve; then read across to the value of pounds of evaporation per square foot per hour. It will be noticed that this chart applies for Pocahontas coal, which represents usual

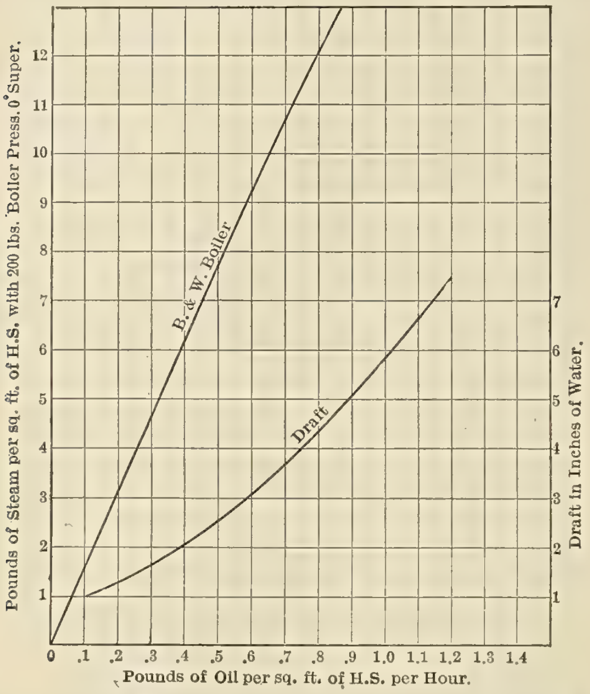


Fig. 5.—Relation Between Rate of Combustion and Capacity for Oil-Fired Marine Boiler

good grades of soft coal, and the values of pounds evaporated plotted at the left of the diagram apply for 200 pounds pressure, which is usual practice for cargo ships to-day. Dr. Lucke does not give an analysis for Scotch boilers, but the curve he gives for a locomotive boiler probably applies closely for a Scotch boiler.

Having already determined the total steam consumed per hour, we divide by the pounds generated per square foot of boiler surface and thus obtain the total boiler heating surface required for the ship.

If the boilers are to be oil fired, we use the chart in Fig. 5 in place of those in Figs. 3 and 4. This chart is taken from Rear Admiral C. W. Dyson's text on "Marine Engineering," and is used in exactly the same manner as Fig 4. It gives us the rate of evaporation corresponding to the rate of firing which is to be used on the ship, and thus determines the required boiler surface in the same manner as stated for the case of coal firing.

The two main factors of importance for the condenser are taken care of by Fig. 6. They are condenser surface and quantity of cooling water. The curves are based on formulas for transfer of heat in condensers, assuming 7 degrees temperature rise, and include such constants as will locate the curves so as to fit a few picked cases for condenser design on cargo ships. The application of these curves needs no explanation.

Conclusion

Since the machinery installed in many ships to-day is bought from different places building a number of standard sizes of equipment, it follows that the sizes actually used in such cases will be the nearest available size to that required by the designer. This probably accounts for some of the inconsistencies noticeable in the proportions of power plants for cargo ships. It is better, therefore, to base estimates on practice as compiled and made into a set of uniform curves than to base specifications on the sizes of machinery installed in certain ships where the determining factor may have been the availability of certain sizes for ready delivery at a low price rather than the service required of the units.

A Sea Going Concrete Barge

The launch of what is claimed to be the lightest seagoing concrete boat in the world has taken place at the yard of the Concrete Seacraft Company, Limited, on the Mersey, at Fiddler's Ferry, a village three miles from Warrington, about twenty miles from the sea. The barge, of 250 tons, designed for the local wheat-carrying trade, is 95 feet long, 21 feet 4 inches beam, and 8 feet draft. It was constructed of a large number of small matured units of concrete prepared beforehand, and then erected on the slip in much the same way as the frame and plate of an ordinary steamship. The units of concrete were then fixed together by means of diagonals of round steel, which bind the whole structure together. The *Elmarine* is the lightest concrete boat for her size which has been built receiving Lloyd's classification. The thickness of sides is 1¾ inches, instead of 3½ inches, which is the requirement of Lloyd's for boats built on any other method.

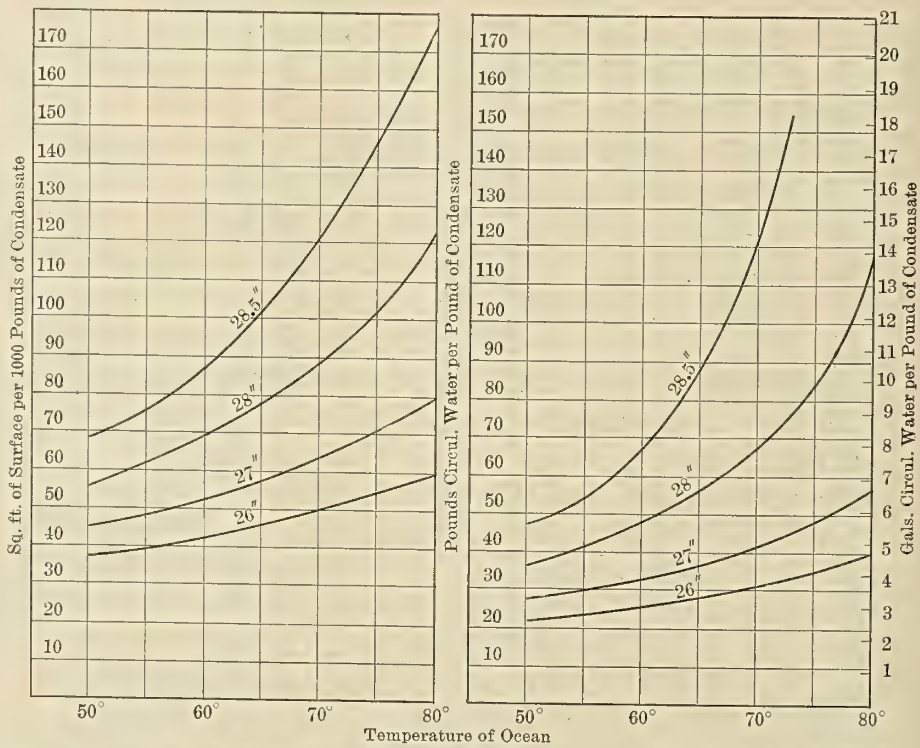


Fig. 6.—Curves for Main Condensers Adapted from Formulæ on Page 475 of A. S. M. E. Transactions for 1916 Which Relate to Marine Work. Use 75 Degrees for Ordinary Designing

Machinery for American Merchant Vessels

Basic Considerations Governing Selection of Economical Type of Machinery—Research Work Under Government Control Urged

BY COMMANDER H. C. DINGER, U. S. N.

THE United States is building a large merchant marine and will probably continue to build merchant vessels on a large scale for years to come. The success of these vessels commercially will be dependent to a very large extent upon whether their machinery installations are satisfactory and whether they are those most suitable for the particular type of vessel and for the service in which the vessel will be placed.

There are numerous types of marine machinery from which to choose, and a wise selection from among these types may make the difference between success and failure of the United States in operating merchant vessels in competition with foreign nations. In making the selections of types of machinery, many things should be taken into consideration. Due weight should be given to fuel economy, weight, space, first cost, operating cost, cost of probable repairs, number and quality of the operating personnel required, availability of the fuel in the regions the vessel will operate in, reliability, safety, availability of parts of machinery decided upon. The following are some of the different types of modern marine machinery that may be considered:

Oil engines of the Diesel or semi-Diesel type, either four cycle or two cycle.

Steam reciprocating engines with either oil or coal and Scotch or watertube boilers.

Combination of reciprocating engines exhausting into low-pressure turbines, with any of the variety of boilers mentioned.

Direct-connected steam turbines.

Turbo-reduction gears.

Electric drive.

There are also questions regarding the use or non-use of superheat, different condensing systems, the character of drive for various auxiliaries, such as pumps, winches, dynamos, etc., steam pressures employed and use of feed heating and air heating appliances.

Fuels—Coal Versus Oil

The first question is to consider the type of fuel, that is, coal or oil. Both fuels are available in variable degree and at variable prices. Roughly, 200 gallons of oil (or 2/3 ton) are equal to one ton of coal. In certain regions, on this basis, coal is cheaper; in others, oil. On the Atlantic coast, coal is slightly cheaper, while on the Pacific and the Gulf, oil is cheaper. As long as there is an available supply of either fuel, it is natural and proper that both should be employed, and each, as far as possible, where it has the advantage. To build only oil-burning vessels would be a serious mistake, because for certain routes coal would be considerably cheaper.

The following are some general rules that may be considered as applying:

(a) Vessels plying between ports where coal is cheaper than oil should be designed for the use of coal. This would take in vessels leaving North Atlantic ports and trading with Northern Europe or in the coasting trade on the Atlantic.

(b) Vessels plying between North Atlantic ports and South America and South Africa would also be justified in using coal, provided they carry enough for the round trip, but oil would be equally suitable.

(c) Vessels plying between Gulf ports and South America or South Africa should use oil.

(d) Vessels operating from the Pacific coast, for long-distance voyages, except possibly to Australia, should use oil.

With the different conditions as to supply of fuel and the fact that both coal and oil are available, it would be a mistake to build all vessels for one type of fuel. To get the best results from the available supply of fuel, each should be used in the places where it has the advantage from the viewpoint of economy and availability. The availability of oil fuel may change materially, due to the opening up of new fields. One of the chief sources of this fuel will be Mexico, and there are prospects of additional fields being developed in Colombia and Venezuela. As far as the American continent is concerned, there is prospect of more oil fuel becoming available, hence, vessels using oil fuel for commercial purposes may well be on the increase.

Vessels Using Oil for Fuel

The first question to decide here is whether the oil engine or the steam engine should be used. The answer is both, depending on the type of vessel and her field of operation. The advantage of the oil engine (Diesel) is in economy, but for very large powers, this type of engine is too heavy and too bulky, hence, where we use high power, we will have to pay for it and use the steam engine. Where economy is of special importance for vessels making very long trips to regions where fuel is expensive and for powers within the limitations of the oil engine, the oil engine should hold the field. This would apply to coasting vessels as well as overseas craft.

Of course, both types, within their field, are developed so that they may be considered as being able to work with equal reliability. Doubt as to the reliability of the oil engine within its proper limitations as to size, weight and speed of revolutions, is now a thing of the past.

With this field divided between the oil and the steam engine, there is also the chance for healthful competition and development, the steam engine being developed to secure better economy and the Diesel engine to reduced weight and increased reliability at higher powers. Distributing the building of the machinery among the oil engine and steam engine builders is also a desirable feature, since it distributes the work more widely and creates a condition where more shops may be engaged in the field of building marine engines.

The Oil Engine

The particular field for the Diesel oil engine is on slow and medium speed freighters designed to operate on long voyages and to regions where fuel may be difficult to obtain. For vessels of about 1,500-3,000 horsepower, a very reliable and especially economical installation can be produced.

These oil-engined installations will require but one-half the fuel that the best steam installations do. Less attendants are required and repairs will probably be less than with a steam plant. For the above powers, a four-cycle engine is recommended, chiefly for the reason that it is simpler. Fresh water for piston cooling is entirely

feasible, though successful salt-water cooling systems are also available.

In an installation of this character, a donkey boiler should be supplied capable of being operated by the engine exhaust gases at sea and by an oil burner in port. This boiler should be large enough to operate the steering engine and anchor engine and certain of the winches and pumps. Oil-engine generators should be supplied to operate certain of the auxiliaries and a portion of the winches. It should be arranged that when in port, but not engaged in loading or unloading, the vessel would not require the boiler to be in operation. For this reason, bilge and sanitary pumps should be electrically driven. The steering engine and whistle could have a connection to the starting air bottles so that they could be operated at sea in case the boiler is shut down.

The above arrangement would call for two small oil-engine generators to supply current for the electric-driven pumps for lighting and for electric winches. The boiler would supply steam for the steam-driven pumps and auxiliaries, steering engine, anchor engine, distilling and heating system. A small auxiliary condenser should be fitted to handle the exhaust of steam-driven auxiliaries.

The reason for using steam for the anchor engine, steering engine and certain pumps, while electricity is used for some of the other pumps and auxiliaries, is economy and reliability. If all auxiliaries, including the anchor and steering engine, are to be electrically driven, a generator of considerable size would be needed, and these auxiliaries would be more expensive than their steam counterparts. Some generators are needed for lights, while a boiler is needed for distilling and heating. Therefore, as in any case, a boiler and also an electric generator is to be installed, the auxiliaries can be divided between the two to very good advantage.

When all the winches are needed and in raising anchor, the boiler would be in use. When simply waiting in port, the boiler could be let down and the generator only kept in operation for lighting and bilge and fire purposes. At sea, the boiler can be operated by the waste heat in the exhaust gases, thus adding to the economy of the plant. Heating, distilling, steam for cooking, etc., could thus be accomplished out of waste heat. Boilers operated in this way have been successfully used on numerous merchant vessels and also on United States submarines.

The Diesel engine would have special advantages for vessels trading from Gulf ports or the Pacific coast of the United States to South America, from the Pacific coast to Alaska and the Orient, and from the Atlantic coast to South Africa and to Mediterranean ports. Sufficient fuel for the return voyage can be carried, and any difficulties connected with refueling avoided. On vessels making these long voyages, the ability to cut down the crew to about one-half that required for a steam plant will be a large factor in reducing running expenses.

For low powers, a four-cycle engine with no piston cooling will answer For powers above 1,000 horsepower, the four-cycle engine with piston cooling would be used. For higher power than 3,000 horsepower, a two-cycle engine should be used. It is believed that powers up to 10,000 can be realized in a twin-screw, six-cylinder outfit. Such installations could be employed on large, medium-powered vessels with the special advantage of securing great economy of fuel.

At the present stage of the game, powers above 10,000 horsepower are not considered suitable for oil engines on account of the space and weight required.

The Diesel engine would be suitable to both the slow cargo boat and also the medium speed combined passenger and freighter. Since a very large part of the ocean tonnage will be made up of vessels of this character, it is plain to see that the field of the marine oil engine is a large one and that the sooner the oil engine is generally adopted and developed by the United States merchant vessels for this particular field, the sooner will the United States reap the benefit thereof. The Diesel engine enables the crew to be cut down, but calls for a higher class of engine operatives. Hence, this will enable the oil-engined vessel to compete with vessels manned by lower paid but larger crews.

The United States is particularly well suited for the full development of the oil engine on account of the ready supply of oil on both coasts. Another advantage is that on account of the wide use of automobiles and gasoline (petrol) engines, there are a very large number of men who have some training in connection with the operation of oil engines. It is from the internal combustion engine mechanics of the country and from watch or instrument makers that the operators for marine oil engines should be recruited. The fact that the oil engine installation of a moderately powered vessel is really a clean, mechanical job, free from the dirt and inconvenience of the usual steam plant, but one which requires a high grade of operating intelligence, should serve to attract a very good class of mechanics to this marine field. The engineers of oil-engined vessels should develop into an aristocracy of intelligence among marine operating engineers. Diesel engine mechanics must be more careful in their work than the steam engineering mechanics. For this reason good results are likely to be secured by getting hold of men who have experience in instrument making or other fine mechanical work.

Oil Vessel—Steam Machinery

This type of vessel has its principal field in high powered and high-speed vessels. The types of engines may be, (1) direct-connected turbines; (2) combination of turbines and reciprocating engines; (3) reciprocating engines, or (4) turbo-reduction gear. The latter seems to be the most suitable, particularly for high powers. The combination is about as economical and may be used for medium powers. Except for rather low powers, the reciprocating engine would probably not be used.

Turbo-gearing is lighter, more economical, and occupies less space than any of the other types, and is also cheaper and easier to build; hence, it is natural to expect that gearing will almost monopolize this field.

Watertube boilers appear to be more suitable for oil fuel than do Scotch boilers. Superheaters are advisable as a means of securing economy and there is no trouble to be expected in operating them. They ought to be in as general use on ships as they are in power plants on shore.

For high-speed passenger and freight vessels there is, of course, at present, no real competitor of the turbo-reduction gear. These turbo-gears, when using superheated steam, give a higher economy than anything else except the oil engine, and are the lightest installations.

Several innovations in the power plants of these vessels might be adopted with great advantage. The following may be mentioned:

(a) Use of centrifugal feed pumps.

(b) Use of condensers of the destroyer type with scoop circulation. This gives a much lighter installation and is more efficient at high speeds.

Coal-Burning Vessel

This may vary from the smallest to the largest. The type of engine to be used will depend to some extent on

the powering. For low powers and low speed, there is still quite a field for the reciprocating engine, but for high powers, the turbo-reduction gear would be the answer. For medium powers, the combination of turbine and reciprocating engine might be used.

The reciprocating engine should be confined to powers below 2,000 horsepower. The reciprocating engine is easy to operate and repair and can be taken care of by less intelligent attendants and can stand more abuse than the turbo-reduction gear unit. Owing to this fact, the reciprocating engine should still be installed in the small cargo steamer.

For low powers, the well-designed reciprocating engine is nearly as economical as the turbo-gear, but for high powers the turbo-gear has an advantage of 10-15 percent in economy.

For the low-powered coal-burning cargo boat, the Scotch boiler appears to be the most advisable. Superheat is recommended, except for very low powers or where it is desired to have the installation as simple and as cheaply constructed as possible. For the higher powers, the large tube watertube boiler would be desired. Its principal recommendation is that it weighs less and there is little practical limitation to the size of the unit that may be installed.

Reciprocating Installations

A modern up-to-date reciprocating engine should be designed to secure the best practical economy in steam consumption. To this end a fairly high cylinder ratio of low pressure to high pressure should be employed to enable the expansion of the steam to be properly carried out. Also, cylinder clearances should be reduced to the lowest practical limit. Either a quadruple or a triple expansion engine may be employed, and if a steam pressure of more than 200 pounds is carried, the use of a quadruple expansion engine would probably be justified in units of over two thousand horsepower. The use of steam jackets does not appear to be justified, but special attention should be paid to lagging and covering of steam radiating surfaces. The efficient draining of receivers and the use of these drains in feed heaters should be provided for. Good sized units should use forced lubrication, but this installation would not be justified on small, slow-moving engines.

The use of feed heaters and the utilization of all possible heat in drains should be arranged for. Efficient condensers and air pumps capable of producing a vacuum of 28 inches of mercury with 60 degrees F. water should be required. It is about as easy to have an installation that will produce 28 inches of vacuum as one that will give but 24 inches. For large installations, steam seals on the low-pressure rods and valve stems are recommended for the purpose of keeping out air.

With an efficient cylinder ratio, one that will give 12-14 expansions, on a triple-expansion engine, well designed valves and low clearances (8-12 per cent) and with good condensing apparatus and feed heaters, a reciprocating engine should be able to give a horsepower for 13.5 to 14 pounds of water and 1.3 pounds of coal per horsepower. This result is almost the same that would be secured with turbo-reduction gear, and it looks as if the reciprocating engine, efficiently designed, should still hold on in this field for years to come. There are many shops rigged and ready to build these reciprocating engines, whereas the gears have to be built in shops especially equipped.

Auxiliaries for Steam Machinery

Considerable change may be expected in the construction of steam auxiliaries with the advent of the turbo-gear sets. To begin with, a very good vacuum is desired, hence condensers and air pumps to produce this are required. Reduced cost and lightness can be obtained by adapting the condensing installations that have been successfully developed for United States destroyers. The condensers are of the curved expanded-tube type and the air pumps have a combined wet and dry air pump or wet-air pumps used in conjunction with Parsons augmentor. For high speed and high-powered vessels, the use of scoops for circulating water offers similar advantage to a merchant vessel that it does on a destroyer or scout. The use of the scoop is probably not advisable until the speed is as high as fifteen knots. An auxiliary circulating pump is, of course, fitted on a by-pass of the injection pipe to supply circulating water at low speeds or when backing. With scoop condensers, it is also necessary to have only a single-pass condenser and to have the condensers in the fore and aft line.

Condensers of this type can be considerably smaller than the types that have ordinarily been fitted on merchant vessels. Condensers of destroyers have shown their ability to condense 25 pounds of steam per square foot of surface, the vacuum being 28-29 inches of mercury. Though these condensers are most efficient and light, they are also the simplest and easiest to build. For high-powered vessels, turbine-driven centrifugal feed pumps are recommended, and centrifugal pumps can be used for ballast and bilge service.

For air-pump service, the combined wet and dry reciprocating air pump represented by the Weir dual and the Blake & Knowles twinplex, or a wet-air pump in conjunction with a Parsons augmentor, appear to be the simplest and most reliable installations. Though ejectors in combination with condensate pumps are available, these devices are as yet not fully developed and are not yet in general vogue on vessels.

Lubricating Systems

With reduction gears, the lubricating system is the most important matter and the success of the gear is dependent largely upon the adequacy and the efficient operation of the lubricating system. The De Laval Company have gone extensively into this subject of lubrication of gears and have designed a lubricating system adjusted to conditions on merchant vessels which is very complete. The Emergency Fleet Corporation has required an installation similar to this to be fitted for reduction gear sets on its vessels. With an efficient lubrication system there will be little repairing and overhauling required in connection with the reduction gear sets. Practically all troubles encountered with reduction gears are centered in defects in arrangement or handling of the lubrication system.

Boilers

The first question to consider is the kind of fuel. Shall coal or oil be used? If oil is used, a watertube boiler would appear to be more advisable, for the following reasons: It is lighter and can be built in larger units, and the regulation of burners and their installation on a watertube boiler is easier than on a Scotch boiler. The oil-burning installation is also more easily made. There is little dirt, no ashes, etc., and for this reason oil-burning watertube boilers are not as much subject to deterioration as are coal-burning watertube boilers. To burn oil to the best advantage, heavy, forced draft is required. This does not go well with a Scotch boiler.

If we are to use coal, there is much more in favor of the Scotch boiler, and in certain classes of work it would be better to use it. The advantage of the Scotch boiler

is its reliability under hard conditions of service. It will stand abuse and neglect that the watertube boiler will not stand. It is fairly easy to build, and the ordinary run of marine firemen know how to operate it. Its disadvantage is its weight. For slow-speed cargo boats of small power, the weight does not count for so much, and therefore for coal-burning marine installations of about 3,000 horsepower and less, the Scotch boiler should be used. For this power, two or three boilers give a convenient size from both an operating and a construction point of view.

For high powers, say above 10,000 horsepower, the Scotch boiler should not be used on account of the extra weight required and the number of boilers that would have to be installed. For intermediate powers, around 5,000 horsepower, either the watertube or the Scotch boiler could be employed.

Steam Pressure.—For Scotch boilers, either with reciprocating engines or turbines, pressures from 160-200 pounds would appear advisable. For watertube boilers, 200-260 pounds would be considered best. There is no advantage in going to higher steam pressure. The advantage in economy can be secured by using superheat.

Superheat.—Superheat should be used on both Scotch and watertube boilers, except for very low-powered installations. With reciprocating engines, the initial temperature of steam should not exceed 500 degrees F. and with turbo-reduction gears 550 degrees. Higher temperatures than these would require the use of special material in piping and fittings, which may present some difficulty. Ordinary steel and good bronze will handle 550 degrees F. without any trouble. A very considerable increase in use of superheat on boilers for merchant vessels may be looked for.

Air-Heating Devices.—Howden's system for coal-burning Scotch boilers is advisable, and some system of air heating for coal-burning watertube boilers can often be installed to advantage. For oil-burning watertube boilers, using the mechanical system of oil burning, air heating arrangements are hardly justified.

Oil-Burning Systems.—For large watertube boilers, the mechanical system using heavy F. D., 5/8-inch of water, and an oil pressure of 50-200 pounds, gives the best results. For small powers and where Scotch boilers are used, lower air pressures should be used.

Steam atomization is not recommended for any marine installation on account of the waste of fresh water. Suitable mechanical systems for oil burning have now been fully developed.

Forced Draft Blowers.—High-speed fans, driven by steam turbines, are recommended over either motor drive or small reciprocating engines.

Standardization of Auxiliaries.—If the steam and electric auxiliaries for our merchant vessels could be standardized to a greater extent, so that practically all these auxiliaries were manufactured in large numbers according to standard patterns, the cost of manufacture would be very much reduced, the apparatus would be more highly developed, and operations would be much easier and better understood. This particular thing is something that the Emergency Fleet Corporation can promote, since at present it controls the design and requirements for most of the United States merchant vessels building.

Summary

It will be seen that the principal innovations of recent development are:

Extensive use of turbo-reduction gears and of oil engines.

Use of superheat.

Extension of the use of watertube boilers, particularly where oil is used for fuel.

Use of better and improved condensing apparatus with all types of steam machinery.

More general and more efficient use of feed heaters.

More general use of small steam turbine for driving auxiliaries.

The following economical results may be expected from the various types of machinery:

Type of Machinery	Pounds Per Shaft Horsepower, Oil	Pounds Per Shaft Horsepower, Coal	Pounds Water Per Shaft Horsepower	Horsepower Per Sq. Foot Heating Surface
Turbo-reduction gear, 5,000 horsepower and up. Watertube boilers, superheat	.85	1.3	11-12	1
Reciprocating engines, Scotch boilers, superheat	1	1.4	13-14	1.8
Reciprocating engines, Scotch boilers, no superheat	1.1	1.55	13.5-14.5	1.8
Oil engines, four-cycle	.45-.48			
Oil engines, two-cycle	.48-.52			

By far the largest items of expense in operating vessels are the fuel and the pay of the engineer's force. Hence, successful designs of machinery will have as some of their principal aims the securing of economy and the possible reduction of the operating force. Heretofore, first cost has too often been the deciding factor. The operating expenses in a few years will make up the slight differences where lower first cost has caused the sacrifice of economical design. Where many vessels are being built according to the same designs, the importance of extreme perfection in the design is vastly increased, for then a defect or an advantage are both multiplied many times. Conservation of fuel and of operating labor are the particular fields that the design of our merchant ships machinery should exploit. If this is done successfully, it will give the United States merchant marine a vantage point. If it is neglected, it may mean the inability of the United States merchant marine to keep up with foreign competition.

It is believed that research work into this question of economical design and experimentation should be undertaken by the government in order that the best possible advancement in practical improvement may be made and that our shipping industry may secure the advantage of this. Private enterprise cannot afford to go into this research and experimentation to any great extent, and the development of the best possible practice in marine engineering is a public matter, something belonging to the country as a whole. Just as the roads and canals are public utilities, whose efficiency is of vital general interest, so the efficiency of our operation of the highways of the sea is a matter that should receive the attention of the Federal government and its support in development.

Considerable research and some experiment in engineering has been done by the navy. Much of this is of great value to the merchant marine, but the operation of merchant vessels also has certain problems that are outside of naval work, and for this reason there should be some public agency to look after these interests. Such a field would naturally fall to the Department of Commerce, which already has several offices which, if enlarged and strengthened, might take over this work (Bureau of Navigation and Steamboat Inspection Service). Pioneer work in this field is also being done by the Society of Naval Architects and Marine Engineers, and by the American Bureau of Shipping; but the importance of building and holding on to an efficient American merchant marine is so overpowering that further steps to perfect and increase these institutions are imperatively necessary.

Efficient Layout and Management of the Plate and Angle Shop in Shipyards

Size of Shop Determined by Speed of Conveying Material to Ships—Arrangement of Shop and Method of Storing Materials

BY G. F. S. MANN, B. S.

TO lay out and manage a plate and angle shop efficiently, it is necessary to have a clear understanding of the building schedule. That is to say, the number of tons of plates and angles that have to pass through the shop each working day must first be determined. It is customary in small yards to lay the keels in rotation and not simultaneously. Thus if twelve hulls are to be built in one year, and if only one building way is to be used, it is necessary to have enough punches, shears, etc., to prepare the steel for one ship in one month.

The Transportation Problem

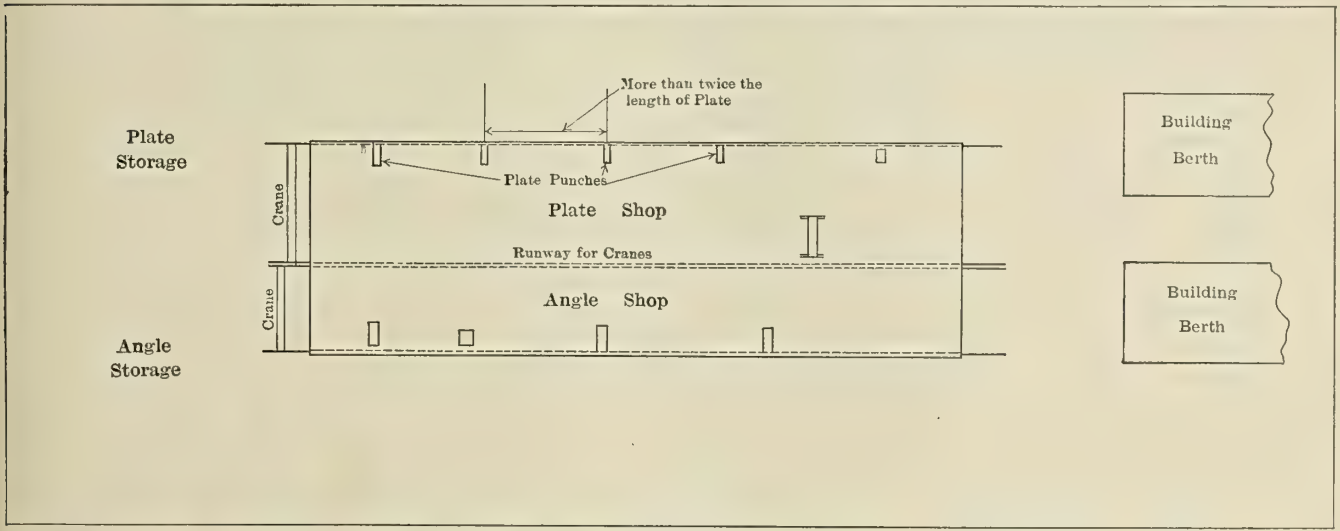
One factor that is of the highest importance in determining the size of the plate and angle shop is the transportation problem. Whatever conveyance is used to take the steel from the shop to the hulls must be loaded at the shop, taken to the ship, unloaded there and then brought back empty to the shop. The time taken for this cycle of movements limits the number of trips that can be made in a day. Therefore, if the number of conveyances is for any reason limited, an example of such a reason being a single track, thus preventing the return of empty cars to the shop while loaded ones are being sent to the ship, the number of punches and shears, etc., must be proportionately increased so that there is always sufficient steel ready to be loaded at each return of the empty conveyance to keep up the daily output of tonnage.

Dividing the total daily tonnage as called for by the schedule by the total number of trips that all the conveyances can make in a day gives the number of tons that must be carried at each trip. Care must be taken, however, that an over-accumulation of finished pieces does not collect and so interfere with the efficient handling of the machines.

From the above it will be seen that the transportation from the shop to the hulls is one of the factors which determines the size of the shop for a predetermined daily output per ton.

Order of Handling the Work

There are three classes of work to be considered, namely, straight, cold bent work, and furnaced work. The number of plates that have to be furnaced is so small that they should be bent to shape and laid off in another part of the yard before they are sent through the plate shop, so that the special processes applied to them do not interfere with the straight work. Every plate and angle should be worked from the storage racks through the shop towards the hull, and not a single piece of material should be carried away from the ships, or back-stepped, as it is technically called.



Sketch to Show General Method of Laying Out Shop

Layout of the Shop

The plate and angle shop should be a long, narrow building with its longitudinal axis perpendicular to the waterfront when it is designed as a single unit to serve only a few hulls at a time. Angle shears and punches should be arranged down one side of the building and the plate shears and punches down the other side, so that the plates and angles can never get in each other's way. This important point is frequently overlooked in some of the smaller shipbuilding plants.

In laying out the shop, care must be taken that the plate punches are farther apart than twice the greatest length of plate which will be handled. Unless they are so arranged, there will be a considerable loss of time, owing to one machine being blocked by the end of the plate which is being punched in the adjoining machine.

Not only must the machines be properly spaced, but they must be arranged in the order in which the different operations are done, so that the plates and angles can be worked through the shop without being back-stepped. The

EXPERIMENTS ON SIMPLIFIED SHIP FORMS

Conducted in the Model Towing Tank at the University of Michigan, Ann Arbor, Mich.

Y. 1

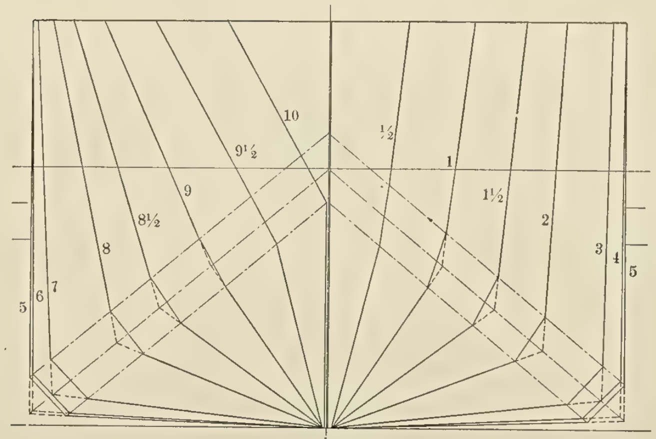


Fig. 1

Y. 2

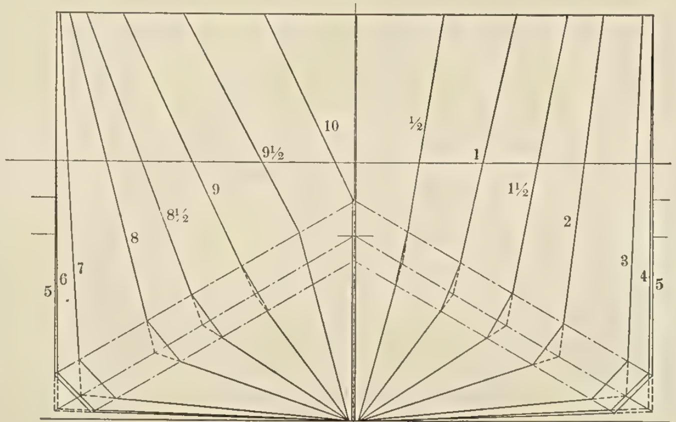


Fig. 2

Y. 1 *c*

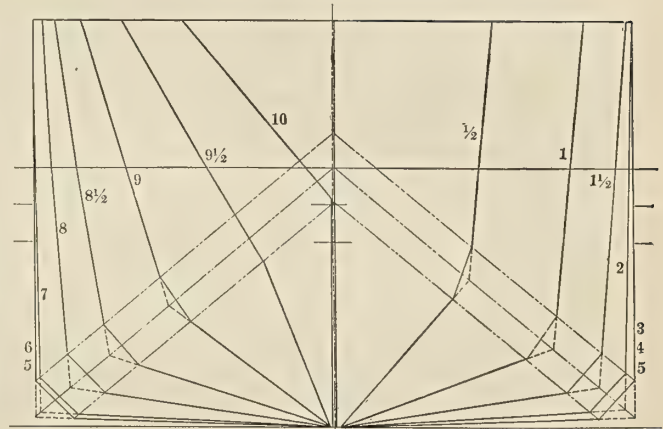


Fig. 4

Y. C.

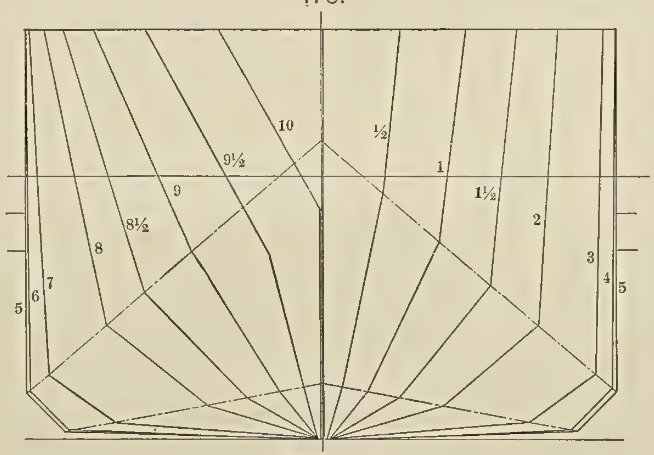


Fig. 1 *a*

Y. 3

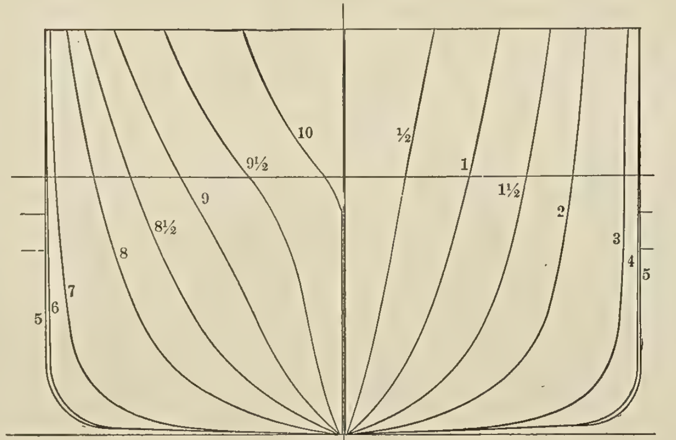


Fig. 3

Y. 3 *c*

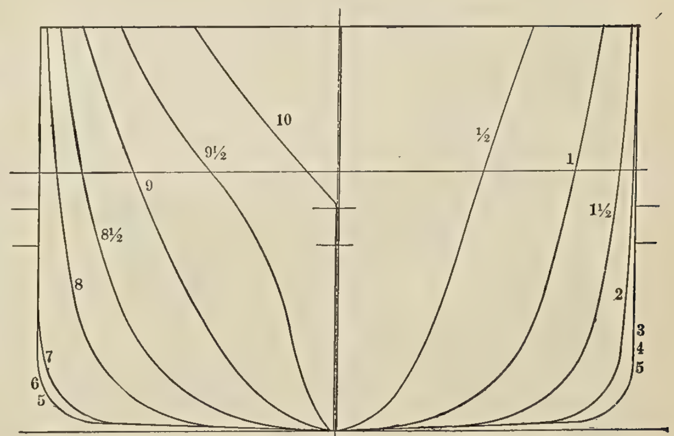


Fig. 5

Body Plans of the Various Models Tested

building may be divided longitudinally by a row of columns, the side on which the plates are handled being wider than the side in which the angles are handled, in the proportion of about seven to five.

The easiest way to handle the plates and angles in the building is by means of two overhead cranes, one of which is installed in each side of the shop. The runways for these cranes should extend out of both ends of the shop, so that the same cranes may pick up material at the storage end of the shop, then bring it into the shop, and, finally, carry it out of the other end when it is ready to be taken to the ship.

The plates and angles must be stored in such a way that any piece of material which may be needed at any particular time can be picked up without having to handle any other pieces first. Plates should be stored on "A"-shaped racks, the end of each rack being clearly marked for the kind of plate to be stored there. The plates are then unloaded from the cars onto their own racks.

The storage yard should be served by a cantilever crane for carrying the plates and angles to the shop, but a long boom locomotive crane may be used. The sketch shows the arrangement of the plate and angle shop as described in this article.

If the plates are not put on racks which are properly labeled, but are piled flat in heaps, several plates may have to be lifted off the pile before the one which is wanted is reached, thus causing great delay, which in turn means unnecessary loss of time and money. If the plates were to be stored flat in heaps it would be necessary to have them loaded onto the cars at the rolling mill in the order in which they would be used in the shipyard; that is, the plate that is wanted first for the ship should be put at the bottom of the car, the others being loaded on the car in the order in which they will be needed. When these plates are unloaded in the shipyard the plate that is wanted first would then be on the top of the pile.

It will be readily seen that such an arrangement of storage, although theoretically possible, could never satisfactorily work out in practice.

In conclusion, it might be mentioned that the steel should be ordered on such a schedule that it will arrive at the yard in as short a time as is practicable before it is needed for the ships.

Experiments on Simplified Ship Forms*

Comparative Resistance of Ordinary Shipshape and "Straight Frame" Models—Factors in Design Which Tend to Increase Resistance

BY PROFESSOR H. C. SADLER AND T. YAMAMOTO

THE question of the simplification of ship forms is one that has received a good deal of attention during the past year. In their anxiety to produce a simple form from a structural standpoint, a good many designers, not familiar with ships, have ignored entirely the question of economical propulsion. During the past year some experiments upon "straight frame" forms have been conducted in the tank at the University of Michigan, and the results are thought to be of sufficient interest to place the same on record.

The main object of the experiments was to determine what difference in resistance existed between an ordinary shipshape form and one in which the curved form of the frames was replaced by straight lines. No particular attempt was made to develop the best possible form, but the main features of the two types were kept constant.

The diagonal line representing the corner was in all cases made a straight line, with the view that, if the bilge corner were cut off, this would facilitate construction.

The body plans shown in Figs. 1, 2, 3, 1a, represent the various forms used. The models were 10 feet long and 16 inches wide. For each particular type the following characteristics were kept constant, viz., length, breadth, draft, displacement (at load draft with the corner cut off), the curve of sectional areas (and hence prismatic coefficient), and the shape of the waterline.

The models were tested at three different drafts covering the usual range.

In each case the model was first tried with the sharp corner, and latterly this was removed.

Two different slopes were given to the bilge diagonal to determine the effect of this feature.

In one case also the lower knuckle was given a small enough slope to keep it within the double bottom; the top knuckle in this case remaining the same as in form Fig. 1.

The following table gives the characteristics of all the forms tried.

Y. 1 (CORNER OFF)

Draft, Inches.	B/d		0 Percent	10 Percent	20 Percent
7	2.285	Long. coeff	.674	.707	.739
		Block coeff	.655	.688	.718
		Mid. coeff	.973	.973	.973
		Waterline coeff	.760	.784	.808
6	2.66	Long. coeff	.662	.697	.728
		Block coeff	.641	.675	.706
		Mid. coeff	.969	.969	.969
5	3.2	Long. coeff	.646	.681	.716
		Block coeff	.621	.655	.688
		Mid. coeff	.962	.962	.962

Y. 2 (CORNER OFF)

Draft, Inches.	B/d		0 Percent	10 Percent	20 Percent
7	2.285	Long. coeff	.674	.708	.739
		Block coeff	.655	.688	.718
		Mid. coeff	.973	.973	.973
		Waterline coeff	.760	.784	.808
6	2.66	Long. coeff	.662	.697	.729
		Block coeff	.641	.675	.706
		Mid. coeff	.969	.969	.969
5	3.2	Long. coeff	.646	.683	.716
		Block coeff	.623	.659	.691
		Mid. coeff	.965	.965	.965

Y. 3

Draft, Inches.	B/d		0 Percent	10 Percent	20 Percent
7	2.285	Long. coeff	.673	.706	.737
		Block coeff	.655	.688	.718
		Mid. coeff	.974	.974	.974
		Water Line coeff	.760	.784	.808
6	2.66	Long. coeff	.661	.696	.728
		Block coeff	.641	.675	.706
		Mid. coeff	.970	.970	.970
5	3.2	Long. coeff	.647	.683	.718
		Block coeff	.623	.658	.692
		Mid. coeff	.964	.964	.964

* Paper read at the twenty-sixth general meeting of the Society of Naval Architects and Marine Engineers, Philadelphia, November 15, 1918.

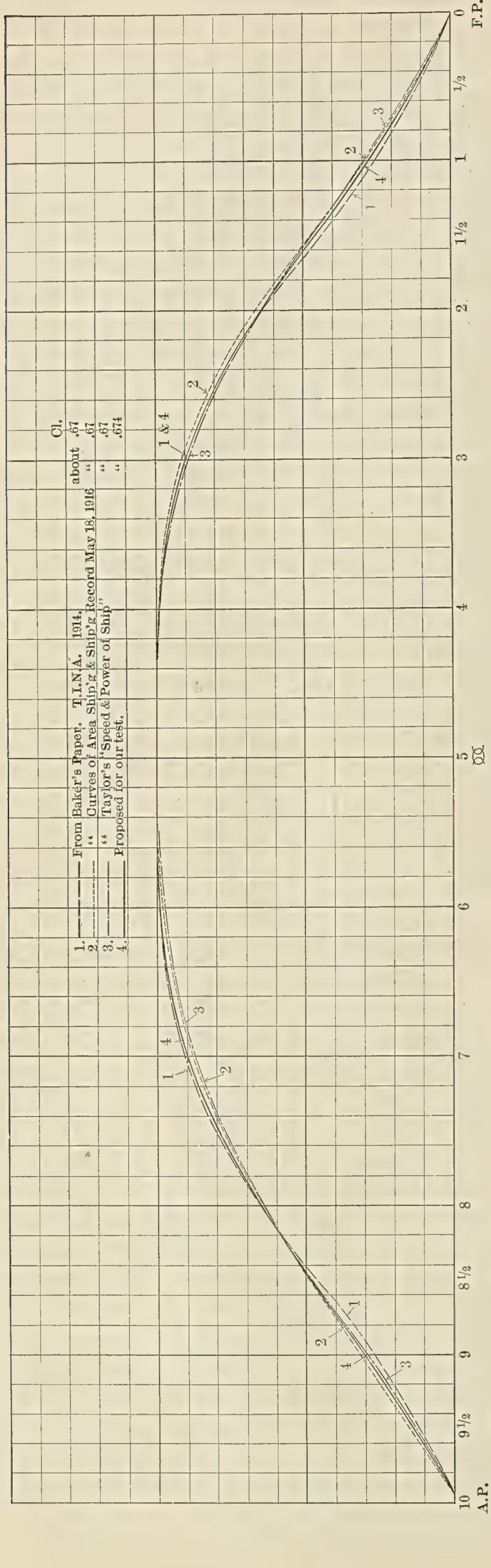


Fig. 6.—Curve of Sectional Areas

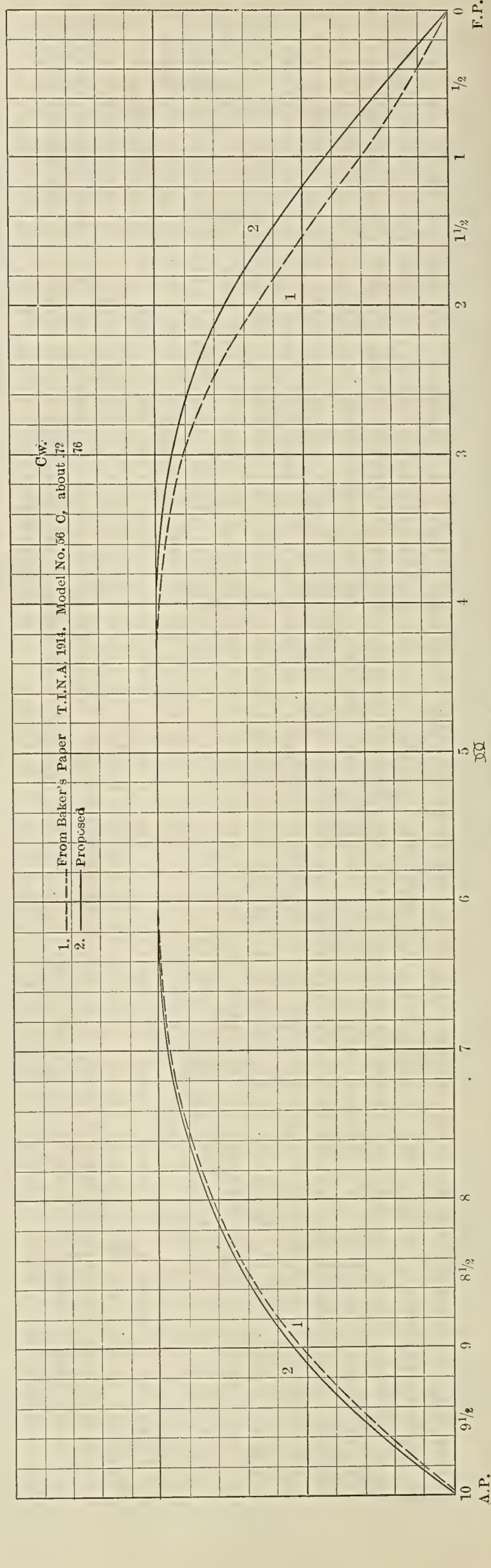


Fig. 7.—Plan of Load Waterline

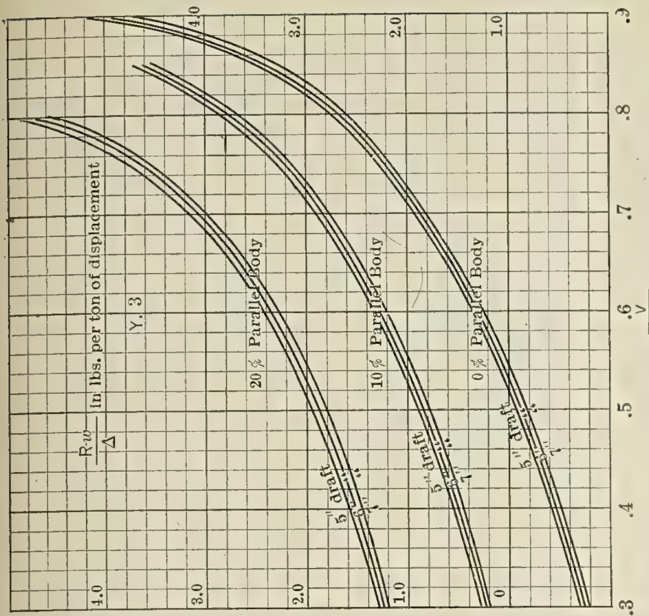


Fig. 10

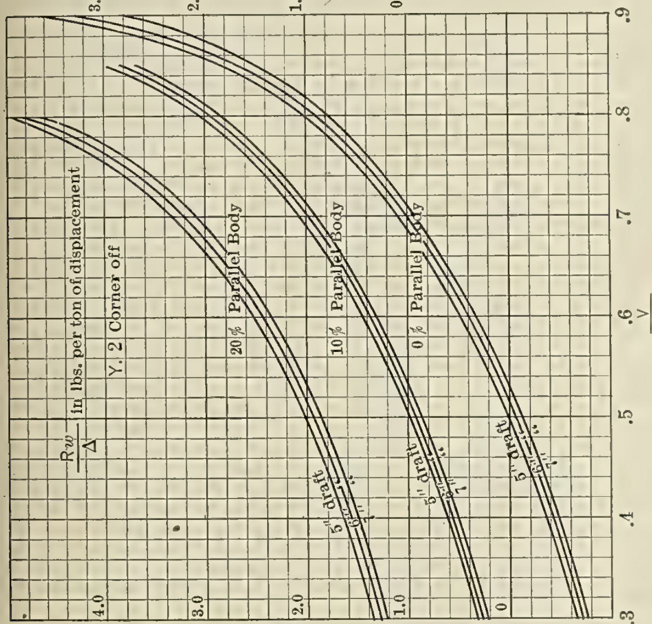


Fig. 9

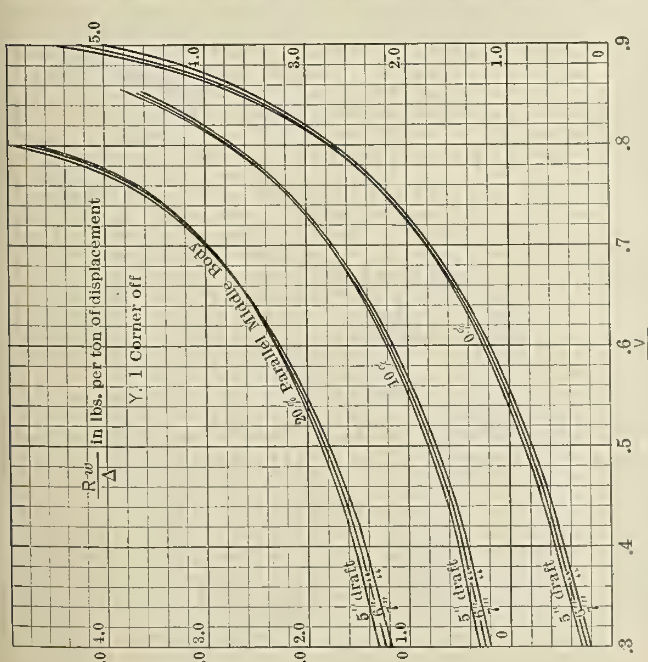


Fig. 8

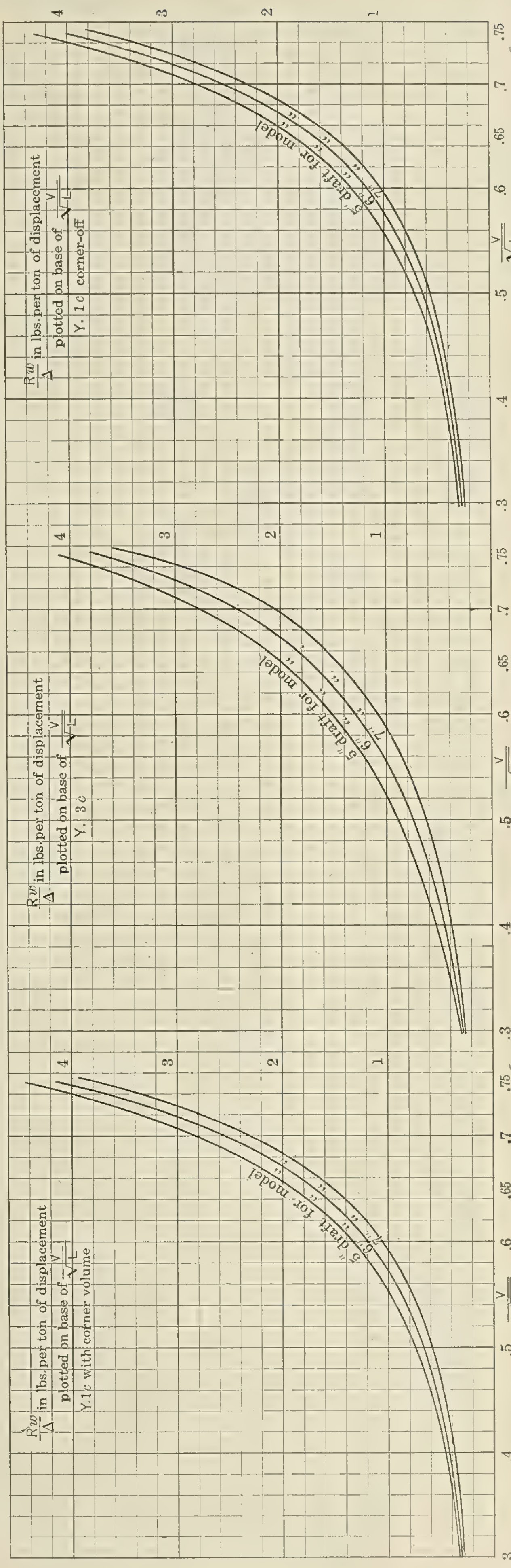


Fig. 11.—Results of Tests in Series 2

Y. 1 (WITH CORNER VOLUME)

Draft, l	/d		0 Percent	10 Percent	20 Percent
7	2.285	Long. coeff.	.673	.706	.737
		Block coeff.	.660	.693	.724
		Mid. coeff.	.983	.983	.983
		Waterline coeff.	.760	.784	.808
6	2.66	Long. coeff.	.661	.696	.728
		Block coeff.	.647	.682	.713
		Mid. coeff.	.979	.979	.979
5	3.2	Long. coeff.	.644	.679	.712
		Block coeff.	.628	.662	.694
		Mid. coeff.	.975	.975	.975

Y. 2 (WITH CORNER VOLUME)

Draft, l	/d		0 Percent	10 Percent	20 Percent
7	2.285	Long. coeff.	.672	.706	.737
		Block coeff.	.659	.694	.724
		Mid. coeff.	.983	.983	.983
		Waterline coeff.	.760	.784	.808
6	2.66	Long. coeff.	.660	.695	.728
		Block coeff.	.646	.680	.713
		Mid. coeff.	.979	.979	.979
5	3.2	Long. coeff.	.646	.679	.716
		Block coeff.	.630	.662	.698
		Mid. coeff.	.975	.975	.975

Y. C.

Draft, l	/d		0 Percent	10 Percent	20 Percent
7	2.285	Long. coeff.	.674		.738
		Block coeff.	.656		.718
		Mid. coeff.	.984		.984
		Waterline coeff.	.760		.808
6	2.66	Long. coeff.	.661		.729
		Block coeff.	.641		.706
		Mid. coeff.	.969		.969
5	3.2	Long. coeff.	.644		.715
		Block coeff.	.620		.688
		Mid. coeff.	.963		.963

The fuller models, marked 10 percent and 20 percent, were obtained from the finer forms by adding 10 percent and 20 percent middle body and contracting the form of the ends to keep the length constant.

The curves of sectional areas and load waterline are shown in Figs. 6 and 7, and in connection with the latter it will be noticed that, in order to use the same form in all cases, this necessitated a somewhat fuller line forward than was compatible with ease of propulsion. For purely comparative purposes it was deemed advisable to keep the same waterline throughout.

The general results are summarized in the curves, Figs. 8, 9 and 10. A comparison of each set of curves for each type shows that the shipshape is the best, and that, of the other two forms with the corner off, the one with the steeper slope to the bilge diagonal gives better results than where this is at a smaller angle.

At the lower speed-length ratios there is little, if any, difference, and such as there is, is of the order of 1 to 2 percent. The effect of retaining the sharp corner appears in all cases to increase the resistance, *i.e.*, the resistance increases at a somewhat more rapid ratio than the added wetted surface. The remaining form with the lower knuckle line dropped (Fig. 1a) shows slightly more resistance than the best of the other forms, but the amount is small; in fact, it seems to lie between the first two forms.

A similar set of tests was carried out upon a model of fuller form. In this case the curve of sectional areas was changed to one suitable for this type. The body plans are shown in Figs. 4 and 5. The particulars of the models are given in the following table:

Draft B/d		Y. I. C. Corner off	Y. 3. C.	Y. I. C. with Corner Volume.
7" 2.285	Coeff.			
	Long. coeff.	.801	.798	.801
	Block coeff.	.779	.779	.785
	Midship coeff	.973	.976	.981
6' 2.66	Long. coeff.	.791	.788	.791
	Block coeff.	.766	.766	.773
	Midship coeff	.968	.972	.978
5" 3.2	Long. coeff.	.780	.778	.780
	Block coeff.	.749	.750	.759
	Midship coeff	.961	.965	.974

The results of the tests, shown in Fig. 11, in general are of the same character as in the previous series. The effect of retaining the corner volume at the bilge is to increase the resistance about 3 to 4 percent, or approximately the same as that due to the added surface. Compared with the shipshape form, there is practically no difference in resistance between this and the simplified form with the corner cut off.

Although time did not permit of carrying out a complete set of rolling experiments, some of the models were tried and it was found that the effect of the sharp corner upon the reduction of rolls was most marked, and that even with the corner removed these models came to rest quicker than the shipshape form.

The general conclusions that may be drawn are as follows:

1. Vessels of the straight frame type can be designed which will have about the same resistance as a shipshape form.

2. If the diagonal line of the corner be given the wrong slope, this will increase the resistance due to the lack of conformity with the proper stream line flow.

3. The effect of maintaining the square corner is to increase the bare hull resistance, but as vessels of this form would not need bilge keels the net result from a horsepower standpoint would be about the same as for a shipshape form.

4. Probably the best results from a resistance standpoint would be obtained by using diagonal line which is of a curved form in the body plan.

Fuel Saved by Increasing Boiler Efficiency

Effect on the Fuel Economy and Cruising Radius of Ships Due to Increasing the Efficiency of Boilers

BY LIEUT. W. D. CANAN, U. S. N. R. F.*

THE large saving in fuel, which can be effected by a comparatively small increase in the efficiency of the boiler is not generally realized. This is very strikingly shown in Plate I. Assume, for example, the case of a ship using coal of 14,000 British thermal units, and that the total water rate for both engines and auxiliaries is 15 pounds of equivalent water per indicated horsepower-hour, the boilers operating with an overall efficiency of

* Head of Boiler Department, United States Navy Steam Engineering School, Stevens Institute of Technology, Hoboken, N. J.

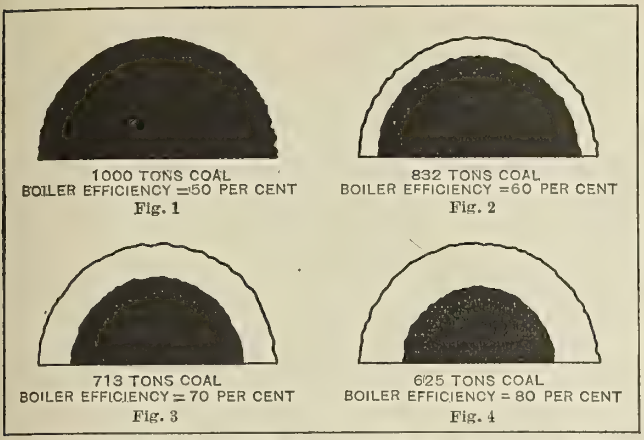


Plate I.—Coal Saved Due to Increased Boiler Efficiency. Heating Value of Coal, 14,000 B. T. U., 15 Pounds Equivalent Water Per Indicated Horsepower-Hour

50 percent. Suppose that, for a given distance steamed, the ship used 1,000 tons of coal, and during this time maintained the water rate of 15 pounds constant. The coal used is represented by Fig. 1. If, now, the efficiency of the boiler had been 60 percent instead of 50 percent, other conditions remaining constant, the amount of coal used would have been 832 tons, or a reduction of 16.8 percent. Fig. 2 shows graphically in the unshaded portion the saving of the fuel due to the increased boiler efficiency. Figs. 3 and 4 show the saving produced by increasing the boiler efficiency to 70 percent and 80 percent respectively. For 70 percent, the saving is 28.7 percent, and for 80 percent the saving is 37.5 percent of the amount of fuel used when the boilers are operated at only 50 percent efficiency. This saving will be practically the same for various water rates and heating values of the coal, and is approximately the same for both coal and oil.

The increase in the cruising radius or, what amounts to the same thing, the total number of hours the vessel can steam at a given rate is shown in Plate II. These curves show the steaming hours per 1,000 indicated horsepower per 1,000 tons of coal for various equivalent water rates and heating values of the coal. For example, if the water rate of a vessel is found to be 21 pounds of equivalent water, and the coal has a heating value of 13,600 British thermal units, for each 1,000 tons of this coal and for each 1,000 indicated horsepower expended at this water rate, the vessel can steam for 747 hours, the boilers operating at an efficiency of 50 percent. However, if the boilers were operating at an efficiency of 60 percent instead of 50 percent, the steaming hours would be increased to 895, an increase of 20 percent; at a boiler efficiency of 70 percent, therefore (other conditions remaining the same as above), the steaming hours would be 1,045, an increase of 40 percent. For horsepowers other than 1,000 and for amounts of coal other than 1,000 tons, the steaming hours are directly proportional.

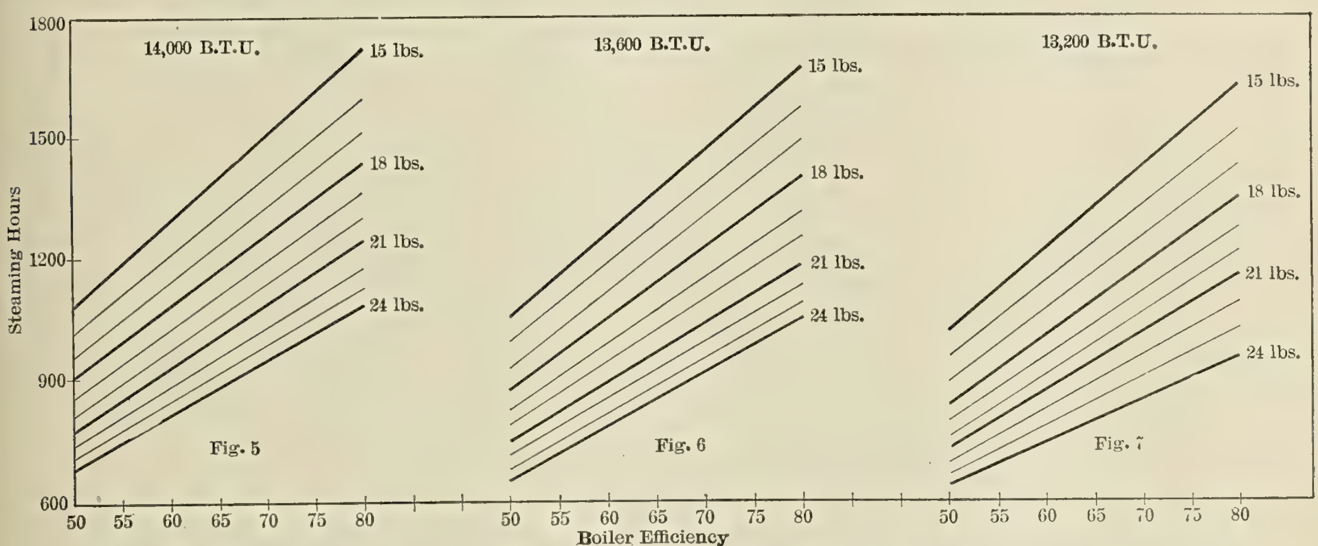


Plate II.—Steaming Hours Per 1,000 Indicated Horsepower Per 1,000 Tons Coal for Various Equivalent Water Rates

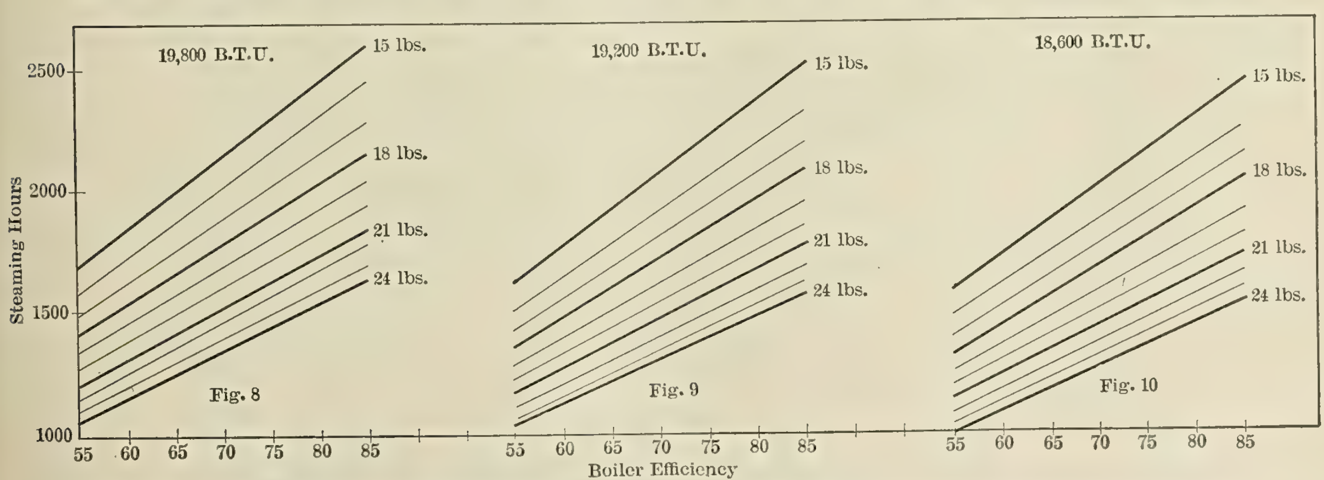


Plate III.—Steaming Hours Per 1,000 Indicated Horsepower Per 1,000 Tons Oil for Various Equivalent Water Rates

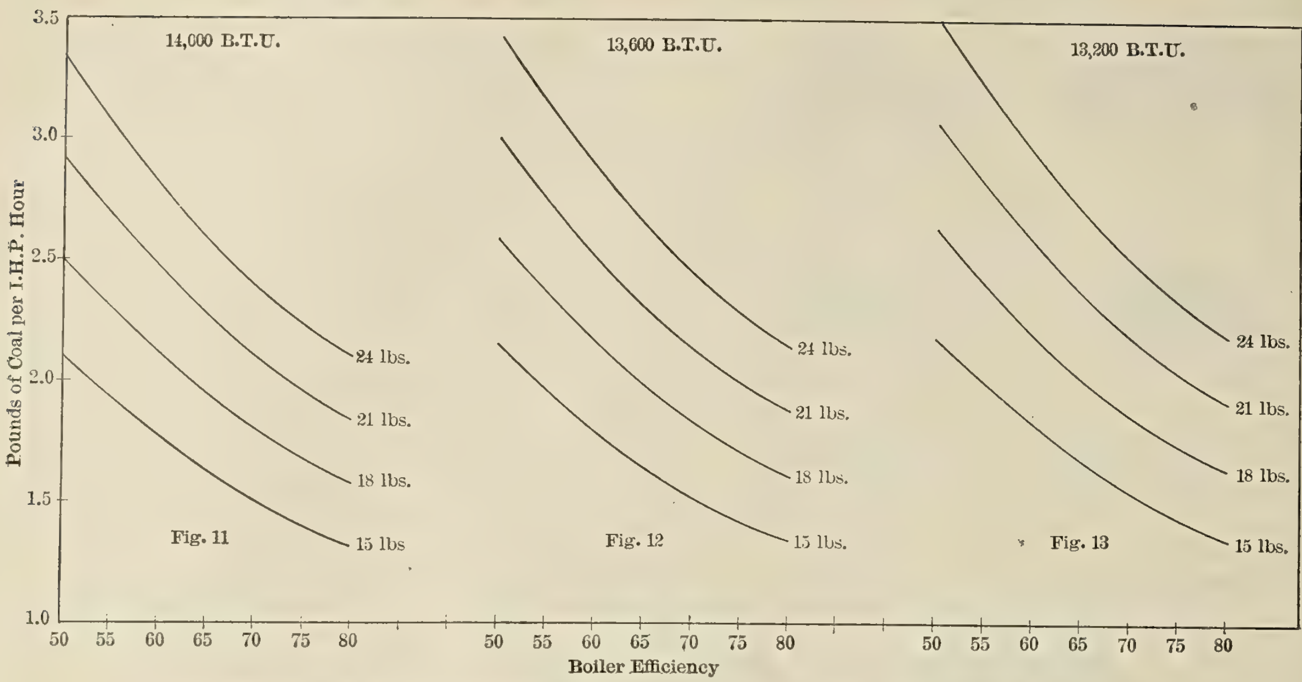


Plate IV.—Pounds of Coal Per Indicated Horsepower-Hour for Various Equivalent Water Rates

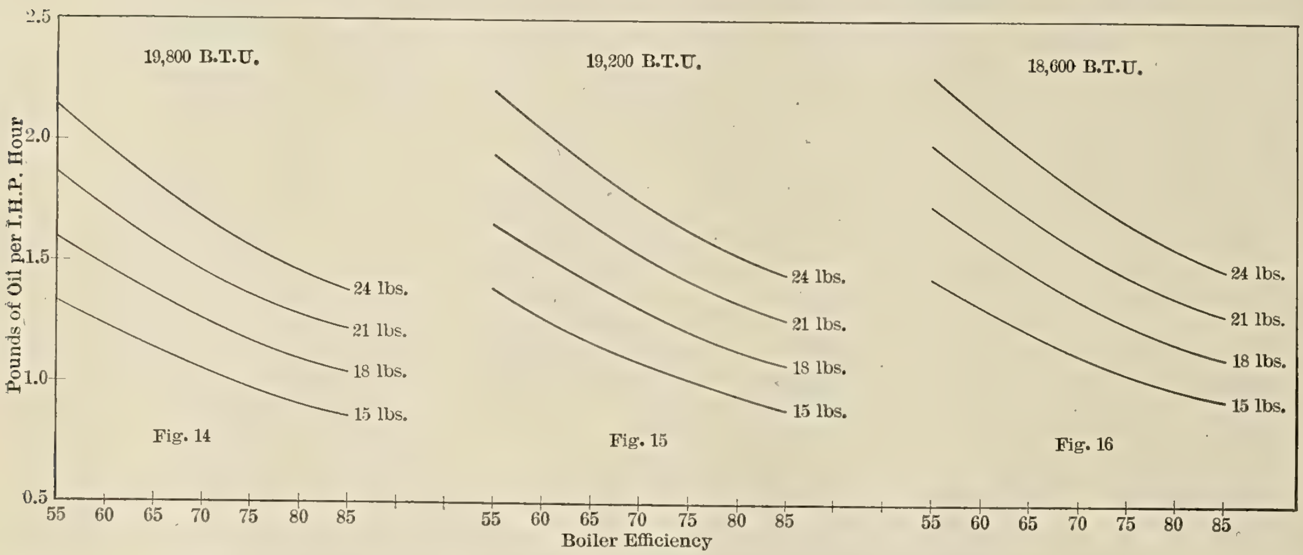


Plate V.—Pounds of Oil Per Indicated Horsepower-Hour for Various Equivalent Water Rates

Plate III shows curves to those of Plate II, but with oil as fuel instead of coal.

Plate IV shows the effect on the coal per indicated horsepower-hour for various water rates due to increasing the boiler efficiency. That is, for coal with a heating value of 14,000 British thermal units and a water rate of 18 pounds of equivalent water, the coal per indicated horsepower-hour for 50 percent boiler efficiency is 2.48 pounds. If the boiler efficiency is increased to 60 percent, the coal is decreased to 2.08 pounds, and for 70 percent boiler efficiency the coal rate drops to 1.78 pounds. Plate IV shows similar curves for oil.

By means of the foregoing curves an attempt has been made to show the marked economy which may result, due to even a comparatively small improvement in the operation of the boilers. Now that the United States has definitely decided to take her place as one of the leading ocean carriers, she will be brought into competition with other countries which can supply cheaper labor to man the ships. If we hope to compete successfully, that is, carry cargoes cheaper than our competitors, our operating costs must be less than theirs. Since our labor costs will certainly not be less, it remains for us to better our maintenance and fuel costs.

So far as the engines are concerned, not much greater economy than has already been obtained can be expected in the near future. The boiler, fortunately, still permits of considerable improvement, and it is to this important piece of apparatus that we must look for any material decrease in the operating expenses.

Correction

In the article, entitled "German Camouflaging," which appeared on page 103 of the February issue of Marine Engineering, it should have been stated that the method of disguise was tried out by United States Government experts on captured German ships instead of by Germans on their own ships as printed, owing to a misunderstanding in editing the data presented.

Marine Boiler Standardization

BY C. A. SELEY

THE tremendous programme of the United States Shipping Board in its shipbuilding activities has developed latent powers in production of boilers in this great country of ours. One would hardly think of going to Battle Creek, Mich., Chattanooga, Tenn., Springfield, Ill., or any one of a score or more of inland towns for marine boilers, yet it has been done and the boilers have been produced.

These boilers are for ships in the proposed merchant marine, for which the Scotch type of boiler has heretofore had preference. Our country, however, had not developed Scotch boiler building facilities to the extent to meet the quick requirements for thousands of boiler horsepower, and the Emergency Fleet Corporation was compelled to design a type of boiler that could be built by inland shop facilities and shipped on standard freight cars to the seaboard to supplement the work of shops more advantageously located as to water shipping facilities.

This article is not to enter into the details of this production, but to note the fact and to call attention to the influence of this great lot of boilers on the marine boiler engineering of the future. It is certainly an impressive lesson on standardization and its advantages in large production and installation. In addition there are those lessons of the future in operation and maintenance to be learned.

Reasons for Standardization

Many hundreds of boilers are similar in details that may need renewals, and there is the double advantage of similarity of parts and of tools and appliances to make repairs. It also greatly simplifies the operating problem in the methods of instruction and acquaintance of the men handling and responsible for steam production to have similarity of equipment and not find a new type or variation on every ship, especially as there are to be "ships, ships and more ships," as the slogan has called for. This all seems even more emphasized by the recent statement of intention on the part of the Shipping Board to effect a world organization to forward the work of administering this country's shipping facilities, which, for the thousands needed to replenish and complete the number of ships necessary will require several thousands of marine boilers.

Advantages and Disadvantages of Scotch Boilers

Adverting to types, the Scotch boiler has certain advantages. Its best, perhaps, is that of long acquaintance. It is accessible for inspection and repair, is integral and self-contained and in a way more fool-proof. Owing to the bulk of water contained, it is less sensitive in maintaining the water level, and particularly so as to effect of salt in the feed-water, if in any amount. It is analogous to the return tubular type of boiler used in land stationary practice, now generally displaced by the watertube type in large plants, where economy of space and costs of operation are ruling factors. It is possible that the same logic of events that has changed land practice in boiler engineering may, as it already has in our navy practice, affect that for the merchant marine.

The marked disadvantages of the Scotch type of boiler are weight and cost per boiler horsepower as compared with those of the watertube type, amounting to ratios between two and three times as against the Scotch. The weight affects displacement and cargo space, the lower efficiency affects coal costs and space. They must be built adjacent to water transportation and handling facilities. Shops must be equipped with special tools and facilities not required for other classes of boiler work. Conservation of steel has been a great need during the war and is still with us and is an important consideration in boiler design.

Cause of Lower Efficiency

Lower efficiency has been mentioned—and the reason is simple. The design of the Scotch boiler does not lend itself well to air admission. This is proven by the amount of smoke from such boilers, denoting incomplete combustion in the furnaces, due to lack or improper admixture of air. Combustion is a chemical process and a proper proportion of air is as essential as to a human being. The so-called combustion chambers are not of much aid in combustion except in the case of long-flaming fuel. We are told that there is no radiation from gases beyond the flaming stage, and on this theory the furnaces of locomotive type boilers have been given greatly increased volume and surfaces more fully to utilize the radiant heat and heat of conduction; and the combustion must be complete before passing into the tubes, as the flame will not pass into small tubes, and their value as heating surface is to extract the heat by convection or contact as the gases pass through them. This is the reason for the great number and small size of boiler tubes, so as to gain a great amount of surface for contact of gases. It is well known that a square foot of heating surface in the furnace is many times more efficient than in the tubes, and that is because the furnace gases are not only hotter, but radiate and conduct heat, whereas, the same gases when they reach the tubes can only heat by contact.

Combustion chambers have been added to locomotive boilers to increase the volume for combustion and additional heating surface to utilize resulting heat in such boilers. These, however, are an extension or part of the furnace permitting a more complete mixture of air and gases and to aid more fully in their combustion at the high rate common in locomotive service.

Combustion in the Scotch Boiler

In Scotch boilers, however, the air admixture and combustion are probably as fully completed as they will be while in the furnace and the function of the chambers is mainly as a passage for the gases from the furnaces to the tubes, absorbing some heat, it is true, though mainly from convection or contact and not to the extent ordinarily supposed. If the area of cross section is sufficient to pass the gases, an increase is not of the proportional value as is the heating surface, which has the benefit of radiant and conducted heat.

It is not at all likely that Scotch boilers will lose favor with many engineers, but will continue to be built for many ships, and for this reason it is believed that some features of standardization and conservation may be timely. In many designs the water-ways at the back and sides of the combustion chambers are made tapering, for which there seems to be no good reason, and in fact a waste of the sheet material, time in laying out and no opportunity for standardized staybolts.

It is assumed that the main reason for the taper is the theory that it assists in water circulation, but it is very doubtful if such is actually the case. As has been pointed out, the combustion chamber walls are not very active heating surface and the water circulation is very sluggish as compared with that in the water legs of a locomotive type boiler of which we have some data as to rate.

Circulation in a Locomotive Boiler

Some years ago, during some locomotive boiler tests on boilers having 58 square feet of grate surface 9 feet

1¾ inches long by 6 feet 4¼ inches wide, carrying 200-220 pounds steam pressure and working to high capacity, it was found that the movement of the mass of water was comparatively slow, being broken by violent local agitations and cross-currents. The average velocity, as noted in a large number of tests, was about one foot per second, with a maximum of not over two feet. The velocity of the steam bubbles through the water was found to be in line with that of free air bubbles rising in water which can be observed independent of boiler operation, but in these tests averaged about 12 feet per second. As the water spaces in this case were less than those usually found in Scotch boilers and the rates of service were approximately 1,000 horsepower, it is believed that the circulation of the mass of water greatly exceeded any possibility in Scotch boiler water-ways and there must have been a vastly greater amount of steam bubbles to accommodate.

Making water-ways straight in Scotch boilers saves time in layout and loss of material in shaping the combustion chamber side sheets, at once a simplification and conservation. It will also simplify the staybolting, as with tapered water courses the length of each row increases from the bottom row upward, making as many lengths as there are rows in many cases.

Standardization of Staybolts

Many shops accept these conditions on the theory that there is a certain amount of variation in assembly of the boiler parts, and some amount of variation is essential in the staybolts, and in fact easiest to meet in that way. The thousands of staybolts in watertube marine boilers, all of one set of dimensions and lengths, are an example of standardization that at least might suggest some economies in that line in Scotch boiler practice. Indeed one very large shop on the Pacific coast has standardized such bolts, making them complete, threaded and tell-tale hole drilled, ready for application, arranged in bins in ¼-inch variables as to length to meet assembly variations which cannot be readily overcome. These are mainly due to sheet buckling, following the flanging of back heads of the boiler and of the combustion chambers. The total range, however, need not exceed 1 inch, and ¼-inch variations call for only five lengths instead of sixteen or more with tapered water course at the back.

At the sides of combustion chambers there need not be as much variation as at the back, if good work and care in the assembly of the parts are insisted upon. There seems to be no good reason for taper of the side water-ways, as it does not seem materially to assist in tube arrangement nor in circulation. Some designs were noted wherein the centers for striking the sides of combustion chambers were so located as to make the water-ways closer at the top corners than on the horizontal centerline, directly contrary to the circulation theory. Some designs locate the shell seams so that staybolts have to pass through butt-straps, which, if avoided, lessens complication and cost and gives the staybolts a better chance in standardization and service and does not impede circulation.

Iron Versus Steel Staybolts

The drilling of tell-tale holes in the outer ends of staybolts, after application, is a difficult and expensive operation and is entirely overcome by the use of standardized bolts. It is, of course, necessary to apply such bolts with a stud nut or driver, which has been very successfully adopted, instead of using a projecting square, which has to be cut off and wasted.

The use of steel for staybolts in marine boilers is questionable, as it is not borne out in locomotive boiler practice. There is not a locomotive running in this country using steel for staybolts. It has been tried with dead soft and with alloy steels of best quality, as would be imagined from laboratory tests, but did not long survive in service. This is no doubt due to the respective structures of iron and steel. Staybolt iron is built up and has not only slag layers between the sections but in the sections themselves, interposing walls against the progress of a fracture originating in the outer fibers and interrupting the progress of the fracture. Steel is homogeneous in structure, without these slag walls, and a check once started is liable to traverse the whole section. Under these conditions steel staybolts in locomotives were found to break in bunches, so to speak, instead of here and there, and therein lay the danger in their use.

A staybolt with smooth body between sheets has several advantages. It is a conservation of material and time in manufacture and in application and reduces boiler weight without loss of efficiency. It does not offer as good a lodging place for scale as a fully threaded bolt and facilitates washing-out.

The rules of the Inspecting Bureau permit upsetting of boiler stays which would include staybolts and in the case of steel there seems to be no objection on the score of the structure to obtain a smooth body. With iron, however, the case is different, and upsetting drives back and interrupts the continuity of the structure as originally built and found desirable to withstand the stresses to which staybolts are peculiarly subjected. A smooth body can be obtained by forging down or rolling the body, maintaining the structure, conserving material and other advantages. This is believed better practice than threading bolts full length or threading and then turning off the threads between sheets. These practices waste time and material and give a surface not so good as the skin of the iron removed.

Type of Thread Desirable

While a fair fit of the staybolt threads in the sheets is desirable, it is believed that such tight fit as to require heavy wrenching is bad practice. It is manifestly impossible to make straight threads steam-tight, and as the threads are relatively fine, heavy wrenching often tears them and subsequent heading up does not fill them out and secure the close contact and fit of threads essential to continued tightness of the staybolts. Good threads on bolt and in sheets, maintained in application by light wrench fits and proper heading over, will give desired results.

Standardization should also be extended to the threads of stays and boiler fittings. The sharp V thread quite extensively used in boiler practice provides sharp corners at the bottom of threads that invite fracture. Engineering practice has learned to abhor a sharp corner as an incipient break, and in the case of threads to use the Whitworth with rounded tops and bottoms, or the U. S. Standard, with flat tops and bottoms. Either of these contributes much in maintaining good threads in application, as the sharp V threads are more liable to catch and tear.

There are many other points, both in design and in shop practice, in which standardization would be of advantage in Scotch boiler production, and in view of the large questions that a growing merchant marine brings up there is an opportunity for getting together the best minds of the marine engineers and naval architects on this important branch of boiler engineering.

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Shipping Tied Up in Hamburg Harbor

Marine Terminals and Foreign Commerce

Adequate Harbor Facilities Will Reduce American Operating Costs One-Third — Larger Berths for New Cargo Vessels — Improvements Planned by British Empire — Germany's Ship Subsidies

BY H. MCL. HARDING*

WITH peace upon us and the resumption of normal conditions of trade and commerce already under way, the United States has as yet failed to work out any specific plans for taking up world commerce along economical lines. The war emergencies made it necessary to enlarge factories far beyond pre-war capacity. Machinery of the latest type has been installed to make possible high speed production. We have the manufacturing means with us. Raw material has always been available in this country. The factor which we still lack is adequate development of foreign trade to market these products. If the United States is to secure complete employment of her available skilled labor she must provide the means to market all surplus abroad.

England Building Colonial Terminals to Accommodate Large Cargo Vessels

The situation has been clearly realized by Great Britain; even during the war she has been "getting ready." As an example of far-sighted planning the questions which were sent out by the British Admiralty through the British Royal Dominions Harbor Commission may be cited:

"Are there available berths at your port for ships having a length of 1,000 feet, a beam of 100 feet and a draft of 40 feet? If the provision does not exist for such freight carrying ships, what will it cost to provide such berths? How long will it take to construct or to extend the piers or quays to accommodate 1,000-foot ships of the above draft and beam?"

Great Britain realizes that she has always excelled in the design of ships. These had been planned and trimmed to afford the most economical utilization for transportation. She now ventures into what has been a field of German supremacy, namely, very highly developed harbor and terminal equipment, as the above questionnaire illustrates.

The following returns illustrate the co-operation of the British colonies throughout the world.

Adelaide, Australia, reported that she would be able to construct four berths of 1,000 feet in length, 41 to 45 feet depth, for $6,150,000 (£1,300,000). Brisbane promised to spend $7,500,000 (£1,580,000) for port expansion purposes. Melbourne reported that she would have berths of 1,000-foot length, 43-foot draft and 100-foot beam, for which she expected to spend about $350,000 (£73,700). Sydney expected to spend $3,250,000 (£685,000) for a number of larger berths.

Canadian facilities were summarized as follows: Montreal had a 35-foot draft depth available, with long quays; Quebec had a possible 35 to 40-foot depth; Vancouver had a 43-foot depth; Victoria, a 40-foot draft.

Cape Town, South Africa, proposed to expend $15,000,000 (£3,160,000) to qualify according to specifications; Hongkong, with an expenditure of $275,000 (£58,000); Aden, with an expenditure of $4,000,000 (£842,500); Colombo, with an expenditure of $950,000

* Consulting terminal engineer of the Mississippi River Improvement Association.

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General View of Kiel Harbor, Showing Terminal Facilities

(£200,000), and Singapore, with an expenditure of $18,886,000 (£4,000,000). All expected to conform to British specifications. Other shipping ports throughout the world sent reports and promises which outline the thought entering into this post-war trade commerce.

The formulation of this plan for terminal enlargement throughout British colonies and the actual answers received show the well developed policy of scientific and co-ordinated improvement which is on foot throughout the British dominions.

England is also instigating improvements at home. At the port of London, for example, improvements are in progress which will afford a channel up the Royal Albert dock with a minimum depth of about 46 feet. A new dock under construction will have a quayage of nearly two and a half miles. At Liverpool also the new Gladstone dock is now 1,070 feet long; the total improved quayage of the port, including Birkenhead, when completed will be over 37 miles.

The 1,000-Foot Ship Economic Operating Unit

Because of the dire emergency, it was not possible for the United States, in her programme, to consider vessels of the most economical type. The available ways and those which could be quickly constructed made it seem advisable to build many 5,000-ton ships. Recent figures tend to show that vessels of 7,500, 8,600 or 9,000 tons are more economical to operate in the matter of crews, fuel consumption and other operating costs.

It is a well known fact that the larger the ship and the greater the tonnage carried, the less are the transportation or carriage costs. One of the coastwise shipping companies of the United States a number of years ago found that by increasing the carrying capacity of its ships from three thousand to five thousand tons no increase in operating expenses resulted. Accordingly the smaller ships were sold and replaced by the larger ones.

It may be assumed that the 1,000-foot ships will probably have a net carrying capacity of more than 40,000 tons. Cargoes, therefore, when there is ample freight, can be carried at much less expense in one large ship of 40,000 tons capacity than in four ships each of 10,000 tons capacity, since many of the fixed charges are the same in either case. The influence of such large ships in the securing of foreign commerce should receive full consideration.

As yet we have not formulated definite plans for the operation of the huge fleet which is now under American register or building. Such decision, of course, rests with the Administration. The improvement of harbor facilities, however, which is quite as vital for economic operation, can be taken up by the special cities. The increase in operating expenses which may result from the use of the type of vessels available must be balanced by the cheapened operating costs which improved harbor facilities will provide. Those cities which expect to handle the trade should begin work on harbor improvements at once.

Means for Reducing American Operating Costs One-Third

That by correctly designed terminals the time of transferring and handling cargoes in the United States can be

reduced to at least one-third or less the time consumed today is the opinion of competent harbor engineers. San Francisco is alive to the fact that by improvements along this line she will be able to compete with other Pacific ports which are nearer in mile distance to Oriental markets. Commercial cities on our Atlantic seacoast should be "up and doing" along the same lines. This estimation of the reduction of the time which ships lay at the port for unloading may practically be considered a fact. Hence facility for unloading a given tonnage in one-third the time that it takes to complete the work with our present facilities would go a long distance toward reducing high operating costs on shipboard. The initial cost of additional quay construction is, of course, a factor which cannot be obviated. Unfortunately this nation has delayed too long in its construction of adequate up-to-date ships. The retrieval may be well accomplished by bringing our terminal facilities above foreign standards.

Improved American Harbor Facilities Necessary to Compete with Germany

Little is known, as yet, of the new commercial schemes which will be launched with the German commercial fleet. When that nation recuperates they will, doubtless, build larger ships along the lines which were already far advanced when the war broke out. She will also further improve terminal facilities.

Before the war, German terminal costs were about one-third smaller than in the United States. When we are cognizant of the means which will reduce this handicap—harbor improvements—work should be begun at once. Germany has also always had the advantage of excellent co-ordination between rail and ship. This fact is plainly evident from a personal study of the ports and their methods of operation. The utilization of inland rivers and canals, with low railway rates for routing export freight to the seaboard, has been a factor in Germany's struggle with competing nations.

This nation has also relied upon what has been termed "economic penetration," to increase her commercial "fighting" ships—the silent art of obtaining control of American and European steamship companies' lines to further trade possibilities. It is stated that even now, through neutral shipping companies which are secretly controlled by the Germans, substantial interests are being purchased in other neutral shipping companies. The system has many ramifications. Purchases which were made early in the year 1918 may come under this category. It will, of course, be easier to buy small holdings later, so as to obtain controlling interest of these companies, than to purchase fifty-one percent outright at one time. This method of obtaining control of shipping facilities is possible without a great cash expenditure.

Another feature of German operation which bears upon the American problem is the report that as far back as 1917 the Reichstag of Germany was arranging to pay war losses to German shipowners by state subsidy. It was stated that some $500,000,000 (£100,000,000) would be authorized for this purpose. It was also rumored that a proportional greater subsidy was being offered for ships built under war conditions. These subsidies were for cargo carriers. One hundred and fifty thousand tons, it is reported, have already been ordered, at the cost of $90,000,000 (£18,000,000) (500,000,000 marks), with the present value of 18 cents as a basis.

Neutral countries are not to be left behind in developments. Swedish and Norwegian ship companies are being organized, and harbor facilities are being enlarged in these northern parts. France also hopes, with her colonies, and the Dutch, with their East Indian possessions, to increase trade facilities throughout the country.

It is evident from the above data and other available material along these lines that foreign nations are leaving no stone unturned which will aid toward increasing their present possibilities for trade.

The "coming in" of the 1,000-foot steamship carrier which is of 40-foot draft and 100-foot beam, and has a cargo capacity of about 2,000,000 cubic feet, will require sheds at least 800 feet long, 80 feet wide, and a clear height of 35 feet below the trusses. The nation must be ready to handle trade from these boats as well as the cargoes of her own floating equipment.

Piers, sheds and warehouses must be developed to meet these new conditions. Few port terminals, ocean or inland, are correctly equipped in the United States at the present time. Ships without good terminals are like railways without freight stations. It behooves engineers of this country to develop our facilities along the most modern lines. If the United States is to secure its share of the foreign trade, it must take every means in its power to compete on equal terms.

The Personnel of the United States Merchant Marine

BY A MARINE ENGINEER

One of the most important problems before the United States is the question of cost versus competition, of the personnel of the United States merchant marine. Our laws are now such that compensation for men who go down to the sea is said to be prohibitively high.

Many years ago, the writer had an experience which was duplicated in thousands of cases in the United States merchant marine. I served my time at sea in the various subordinate positions and qualified for a license as an engineer. At that time ships were undermanned, and engineers had to put in fourteen to eighteen hours a day to keep their plants up and hold their jobs. A man had to quit his job, if he desired to spend a few days at home. The work on steamships was desperately hard, dangerous and unappreciated. The quarters were poor and the food worse. On one occasion the engineers, by superhuman efforts, kept a ship from foundering in a typhoon. In order to do this they had to cut some of the pump suction pipes. When the ship reached port, the employers, instead of showing appreciation, discharged the engineers because of the damage to the pipes.

This was by no means an individual instance, but typical of the times. Practically all of the better class of engineers sought jobs ashore, and it was this enormous reserve which supplied the marine engineers who carried our troops to Europe. A large majority of the better class of these men are hustling back to their shore positions as fast as they can get their discharges.

The dominating characteristic of human nature is fear —more specifically, fear for the future, fear that one will not have sufficient to live on, fear that one's position is not permanent. Most marine engineers go to sea because they cannot do anything else. The same may be said of ships' officers. There is no class which temperamentally desires to be away from home. American homes are particularly attractive compared to those of other countries. Few sea-going men will admit that they follow the calling for pure love of it, and the better class of engineers invariably leave the sea while still in their twenties, obtaining positions as engineers, mechanics, salesmen, traveling experts, etc.

It does not necessarily require high wages to induce men to go to sea. Why is it that the Civil Service has no trouble in obtaining all the help that it requires at wages considerably lower than the industrial scale? It is because stability, a permanent job, old-age pensions, insurance, etc., are provided. In other words, the Civil Service assures the man that, although his salary is small, he need never worry again about a position nor walk the streets hunting for one. Large corporations, like the Standard Oil, Ford Motor Car Company, United States Steel and others, have practically solved this problem by offering permanence of position.

From these thoughts, the writer ventures to deduce that if a merchant service similar to the navy, but more adapted to merchant needs, be organized, sea-going men can be invited to join this service instead of joining a ship here or there wherever they can get the job and losing the job when the ship is laid up. It could be arranged for men to enlist in this service, as in the navy, and be assured of their pay at all times whether on board ship or not.

The requirements to attract men into such a service would be as follows:

First.—A permanent salary for the time of the enlistment, with the privilege of re-enlistment. This must be a living salary, but not necessarily large. The main requirement is permanence.

Second.—Suitable opportunity for promotion. Ranks could be provided similar to those in the navy.

Third.—Definite ratings and duties.

Fourth.—The high ranks to take the better ships and runs and to have more or less personal choice of duties.

Fifth.—So far as possible the men should be put on steady runs. Under such circumstances they can arrange their lives and domestic affairs with reasonable certainty.

Sixth.—In proportion to merit and seniority the percentage of shore duty shall increase.

Seventh.—Correspondence-educational facilities shall be provided, together with circulating libraries and periodicals.

Eighth.—Suitable port headquarters shall be provided, perhaps in co-operation with one of the great welfare organizations.

Ninth.—Uniforms sufficient for the purpose without unnecessary expense.

Tenth.—Proper provision for cadets and apprentices who are graduates of technical schools or machine shops or both.

That such a system would appeal to marine engineers is the opinion of a man who is one and who knows marine engineers. In the past and at the present time, no marine engineer is at all certain of his next pay day and few are enthusiastic about their profession. The writer realizes that employers have been up against conditions which they could not govern, but he writes solely from the viewpoint of the average marine engineer, because that viewpoint cannot and will not be changed until human nature changes.

Tar Varnish For Iron Work

Heat about 100 gallons of tar to a low boiling point and add 100 pounds of fresh slaked lime sifted over the top and then worked down. Boil this mixture until it becomes pasty. Let it settle for a few minutes and then add 20 pounds of tallow and 5 pounds of powdered resin. Stir until thoroughly mixed and all ingredients dissolved, then allow to cool. The mixture should not be raised to a higher temperature than 100 degrees F. Should the preparation be too thick, it can be thinned down with paraffin or naptha.

This gives a finish like stove enamel. All gas holders and galvanized iron roofs and galvanized sides of buildings are painted two coats with this tar varnish and then whitewashed thoroughly, protecting them from the weather and salt air. The varnish is elastic and will stop corrosion.

Lubricating Marine Machinery

BY W. D. FORBES

Lubrication in the machinery of a vessel is as important as the machinery itself. Yet the subject of lubrication, with special reference to marine work, is given but a superficial consideration outside the province of lubrication engineers. To this end I have written a general article covering all the manifest phases of lubrication in marine machinery, and hope that you will give this article space in your columns.

In the lubrication of marine machinery it is well to bear in mind the fact that when vessels are operated on salt water, fresh water must be used in the boilers, and that besides the water required to fill the boilers an extra amount has to be carried in order to make up for a certain amount of loss in the water's cycle of use. The cycle is well known. The water is turned into steam, which passes first to the main and auxiliary engines and then to the condenser, after which it is pumped back to the boiler by means of the feed pumps or injectors.

As is well known, any oil which finds its way into a boiler is detrimental to the boiler, because it fastens itself upon the sheets and tubes and thus prevents the water from coming in contact with the metal surfaces. This results in their burning out, which shortens the life of the boiler and necessitates repairs, besides increasing the danger of an explosion.

Therefore it is evident that internal lubrication of the engines is inadmissible. A certain amount of interior lubrication will result. Stuffing boxes around valve stems and piston rods must be lubricated of course, and these stems and rods will carry a certain amount of oil into the valve chests and cylinders. In order to get rid of this oil, however, grease and oil extractors are placed between the steam discharge of the condenser and the boiler feeds. Other parts of marine engines which require lubrication, aside from the stuffing boxes, embrace the flat surfaces of the guides and gibs, the arced surfaces of the links and blocks, the oscillating surfaces of the wrist pins in the crosshead, the rotating surfaces of the eccentrics and straps, the main bearings, and those of the crank pins and brasses. Besides these there are the rotating shafts of the blowers, electric light plants, circulating pumps, and the like, as well as the bearings supporting the propeller shafts. These last are lubricated by either grease or oil, or, as in the case of the tail shaft, by a combination of water and oil or by water alone, where the shaft passes through the hull of the ship.

Whether grease or oil is used is a matter of choice on the part of the chief engineer of the ship or company. Usually on the main engines the gravity system is employed. In this system cups or oil boxes are provided, or oil cups with copper tubes leading to the bearings. Where tubes are provided the cups are fitted with some means of controlling the flow of oil. Usually, however, the bearings of the main engines and those of the propeller shaft are not fitted with any means for controlling the lubricant. The thrust bearings usually have an oil cup on each horse

shoe. Sometimes a thrust box is provided so that the collars on the thrust shaft dip into the oil there. The oiling of the link box is quite commonly done by means of oil cups in which curled hair is placed; the lubricant is supplied by means of a squirt can. The curled hair prevents the oil from being thrown out. Not infrequently the squirt can is replaced by oil cups and tubes.

Of course this system of oiling needs close watching. The crank pin is lubricated by oil tubes leading down the sides or fronts of the connecting rods. At their upper end these are furnished with elongated oil cups into which drops of oil fall from the oil tubes. This idea is somewhat modified at times by providing a wiper on the crosshead and crank pin oil cups, so adjusted that at the extreme upper position of the stroke a certain amount of oil is wiped from the end of the oil tube. Long spouted oil cups are used to supply fresh oil to the main bearings.

Another style of lubrication, far preferable, is known as the "forced oil system." In this system the lubricant is pumped through oil pipes, under more or less pressure, to all principal bearings. This system, however, demands an enclosed engine—in other words, a case which prevents the oil from spattering about. Such a case collects the oil in a base. Here it is strained, allowed to cool and again returned to the force pump. This system, which has been common on small engines, is now being applied to very large ones as well. There are two ways of meeting the requirements of reaching oscillating or reciprocating parts as well as crank pins. One is to drill into the crank shaft pin. This throws and forces the oil into the rotating shaft to the main bearings and crank pins, up through the connecting rods to the wrist pins, crosshead shoe, guides and gibs. In this system the piston rods and valve stems, as well as the link blocks, rely for lubrication upon the oily atmosphere in the engine case, which is usually quite sufficient. On very high speed engines of small size this system has proved quite satisfactory. It is open to serious objection, however, on the ground that the oil passages are extremely difficult to clean without dismantling the engine. A second system provides piping leading to the main bearings, and by means of telescopic tubular connections to the crosshead pin, thence by tubes to the crank pin bearings. In place of the telescopic connections, a grass hopper swinging joint or joints with pipe connections may be substituted. If this system is properly installed by the removal of certain plugs, steam can be blown through and the tubing thoroughly cleaned with comparative ease. In either system, however, it must be remembered that oil is lazy and unaccommodating, and will always take the easiest way of movement. Therefore, the sizes of the openings leading to the various bearings must be varied in their diameters, so that the oil will be forced to travel to all bearings in sufficient amount to lubricate them properly, otherwise some bearings will be flooded and others will not receive a sufficient amount of lubricant. The easiest way to accomplish this is to place washers with varying sizes of holes in the ends of the tubes. Because of the lack of understanding of this fact, the forced oil system is often reported as "unsatisfactory." It is, of course, necessary to have a good quality of oil in any system. In the gravity system, however, the quality of the lubricant is most important, as it is not so constantly supplied. In the forced system, on the other hand, where a great volume is constantly applied, the quality of the oil need not be so good. In all cases, the oil must be free from grit and foreign substances.

It is a common idea among men in charge of engines that after the valve chests and cylinders are once oiled it is necessary to continue oiling them. This is a fallacy. In the vertical style of engine, if it is properly made, no friction results on the cylinder walls, save from the pressure of the rings. If the cylinders and rings are well designed and made of proper material, truly machine fitted, this friction is light. By balancing the low pressure slide valves their friction is greatly reduced. In starting up reciprocating engines it is advantageous to introduce plumbago into the steam passages and to run them slowly with low steam pressure. The water in suspension and the plumbago will very soon put a high polish upon the sliding surfaces.

In the modern prime mover, the steam turbine, there are no sliding surfaces. The only things to oil are the main bearings, which in larger units are always done under pressure. These bearings must be carefully watched, as excessive wear would allow the rotor to drop, which in some makes of turbines would result in stripping the blades, causing serious damage.

It is worth while to say in conclusion that, while it is of prime importance to get a lubricant to the bearing, it is of equal importance to determine the point of the bearing at which the oil should enter. In the steam turbine it matters little whether the oil enters directly at the top of the bearing or at its side; in either case the opening should be at the center and not at the ends of the bearings, as oil will invariably work out toward the ends of the bearings, but will not work in toward the center. Where the engine is of the reciprocating type the oil holes should never enter at the top of the bearing but through openings drilled in such fashion as to lead the oil to each side or edge of the bearing. In this class of engine the upward pull of the connecting rod tends to close the oil opening, if placed at the top, just at the moment when lubrication is most needed.

A point often forgotten by engineers, or, more properly, engine builders, is that only one side of the crank pin gets any wear except when the engine is reversed. In laying out the oiling system this fact should be borne in mind. When an enclosed engine is used the very greatest care should be exercised in thoroughly cleaning out the bed so that the oil will not become dirty. Also, it is advisable to paint the interior carefully with several coats of enamel paint—white is the preferable color.

In the use of grease, two systems are employed. In the first, an open box or cup is provided to receive the grease, and the heating of the bearing is relied upon to liquefy the grease so that it will reach the bearing surfaces. In order to facilitate this heating, it is quite common to provide pieces of copper wire which are thrust down through the grease until they rest against the shaft. Since copper is a good conductor of heat, the grease is more quickly liquefied by the heating of these copper pieces. A slight jar or movement of them aids the feeding of the grease and prevents what is sometimes called "caving"—the term used when the grease near the opening to the shaft warms and flows out, leaving a cavity. Quite an amount of extra heat is needed in order to break this down and continue the lubrication.

The second system used with grease is that known as a "compression cup"—automatic or adjustable. A piston is fitted to the cup, and, in the automatic, this piston is forced down into the grease by means of a spring, while in the adjustable type the piston is forced down, from time to time, by a screw passing through the cover or cap. The automatic compression grease cup is advantageously used on the suspension pins of the governor of an electric light engine, as these pins cannot be readily reached by oil tubes. The adjustable cup can be used where it is stationary and can be easily reached.

An Apprenticeship Course for Shipfitters

Lack of Ship Mechanics Handicaps Shipbuilding—College Courses Needed—Shop Instruction Should Correlate Trade Knowledge With Shop Practice

BY W. H. DOOLEY*

THE progressive development of shipbuilding in this country depends upon the technically trained managers, experts, draftsmen, superintendents, foremen, skilled mechanics and helpers, available for the industry. For several generations prior to the war, shipbuilding has been sadly neglected by the American people. The United States Government training schools and a few technical schools, like the Massachusetts Institute of Technology, have been the only educational institutions which encouraged the study of shipbuilding. The experts, managers and draftsmen employed here have either been trained abroad or in one of the college grade schools.

Need of Shipbuilding Experts

In the past it has been possible for men who lacked technical training, but who possessed good common sense and business capacity, to rise to managership in the shipbuilding industry. This is not true to-day. The manager must be a technically trained man, who enters the industry direct from school. Initiative force, a keen analytical mind, and pronounced executive ability are the requisites.

During the ages, progress in shipbuilding has been due to a few scattered inventors and workmen laboring under great disadvantages. Shipping interests are just beginning to see the possibilities of applying scientific discoveries. Competition with England and other foreign countries compels us to realize that shipbuilding has become a science. Old rule of thumb methods must give way. Continuous employment of scientifically trained supervisors is the answer. They will show up the weaknesses which increase the cost of production; they will improve the design of tools and machines, and completely utilize waste products. To provide these men the college grade institutions must institute courses for training experts in shipbuilding.

The Foremen and Job Master

The superintendent of a shipbuilding plant usually comes from the ranks of workers. As such he is the job master of all the intricacies of the work. An additional qualification, however, is the ability to get good work out of men. This means that he must judge human values correctly. His outlook on life must be broader and more comprehensive than that of the worker.

The Skilled Mechanic and Helpers

The skilled craftsman or mechanic should have, in addition to excellent health, a clear, inventive mind. Like the highly skilled machine shop worker, the skilled shipworker acquires by experience manual dexterity and a fund of information which forms the basis for new judgments. Since the skill of the shipowner depends upon his constant practice of the shipbuilding trade, he cannot leave the work for any length of time without losing dexterity.

Helpers and the semi-skilled workers, so necessary in shipbuilding, also need a strong body and the quick, mental perception which guides manual dexterity.

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The lack of properly trained, first-class mechanics in the shipbuilding trades, who are capable of taking positions as superintendents and foremen, is the industry's present handicap. The most effective system of training a first-class mechanic is an apprenticeship to the trade covering at least three or four years. Boys of fifteen or sixteen years of age should be started in the trade under a mechanic. If the boy begins much later, he will probably leave before completing his apprenticeship. Some educators favor sending boys to trade schools until they are eighteen and then allowing them to enter the trade. Such a plan has been worked out in many industrial high schools and co-operative courses, but has failed to produce mechanics who are willing to remain in the productive side of industry. They usually find positions more attractive in the distributive phase as salesmen or buyers of supplies.

Apprenticeship courses may cover shipfitting, shopsmithing, joinery, boatbuilding, plumbing and sailmaking. Similar courses may be established in the machinery division of shipbuilding—machining and die-sinking, coppersmithing, boiler making, pattern making, molding and electrical work.

Training the Apprentice

The apprenticeship course should be in charge of an educational supervisor who has complete charge of the training of apprentices. The carefully planned course, which will be outlined later, divides the material to be considered into two heads: shop or trade practice and related trade knowledge. The course in trade practice, which is given in the shop under the direction of a first-class skilled mechanic, should be arranged so that the apprentice may receive thorough shop experience and not be held on any one type of work at the expense of his training in the other lines. This is one of the most difficult pedagogical problems. The shipyard shop in which apprentices are taught is usually laid out to do commercial work and the foreman holds his position on account of his ability to keep up production. Both officials and mechanics are often tempted to keep apprentices on work which they can do to the advantage of the yard. Therefore, in the interest of the proper training of the apprentice it is necessary to keep a record, a card will be found the most practical, showing the time, allotment in hours or months, for each apprentice in the different lines of work practiced in the trade. At the end of each week the officials, including the supervisor of apprentices, should record the time, in hours, which each apprentice has devoted to each kind of work or machine. In this way, it is also possible for the apprentice to know the time spent on each type of work, so that he may see the progress he is making.

During the early period of the course the apprentice should perform the menial and disagreeable parts of the trade which require little training or skill. For at least one-third of the full course the apprentice should be under the guidance of trained men to prepare for the time when he will be thrown upon his own resources. The shop experience should be graded so that the apprentice develops responsibility, accuracy, and care in the operation of expensive machinery.

One month during the last year of the apprenticeship should be spent in the estimating department to emphasize the need of economical work, as it relates to the cost of labor, time and material. The remainder of the last year should be spent upon working entirely from plans.

Related Trade Knowledge

The related trade knowledge, as outlined in the course which follows, includes such facts as are necessary for intelligent work,—trade mathematics, trade science (that is, the principles of physics and chemistry which are applicable to the trade), shop sketching, interpretation of blueprints and some trade English.

Working Programme for Apprentices

The working week should consist of 48 hours; 40 to 44 hours spent in actual shop practice and 4 to 8 hours spent in studying related trade knowledge. This course may be given in a vacant room or loft.

A formal report upon the work of the apprentice should be sent home every six months. This record also should be placed on the apprentice's life card, a permanent record of the school which should be kept by the supervisor of apprentices. In these reports the apprentice should be graded according to the standards of a successful mechanic, under the qualifications: adaptability, speed, ability to do accurate, well finished work, reliability of conduct and punctuality in reporting for work. In addition, a measure of the apprentice's aptitude for the trade might be entered under the characteristics—initiative, tact, analytical ability, enthusiasm, personality and decision. It would also be valuable to have a record of those qualities in which he excels and those in which he is deficient.

Correlation of Trade Instruction and Shop Practice

Complete correlation of shop trade instruction with shop practice in the various branches is the aim of the course outlined below. The courses in shop English, shop science, shop mathematics and shop drawing in each of the periods into which the complete three years' work of instruction is divided, handle parallel subjects.

For example, while the apprentice, in his shop English course, is having practice in the spelling and description of various tools in the tool room, in his shop science course he is learning the types and manufacturers' names of the tools and their use. Parallel with this is the shop mathematics course, giving practice in solving the simple problems which deal with measurements. These elementary problems, involving addition, subtraction, multiplication, and division, are applied to tools in the tool room. At the same time, in the shop drawing course, the apprentice is gaining practice in making rough pencil sketches of tools, such as chisels, wrenches, hammers, nuts and bolts. Out in the shop during the whole period the apprentice actually handles the tools. He receives them, stows them away, repairs them and issues new tools—all under the direction of an experienced mechanic. All the materials in the stock room, and the hand and power tools, are used for his instruction. The purpose of the whole project is to completely familiarize him with the tools of the shop-fitting trade. A comparison of other parts of the course will show this careful correlation of instruction with shop practice throughout.

A general course in the interpretation of blueprints is first outlined below. The purpose of this course is to teach the apprentice: (1) to understand and work from a drawing or blueprint; (2) to make rough drawings and sketches necessary in the trade; (3) to provide an opportunity during the latter part of the course for advanced or exceptional students to make complete working drawings. Since the aim of this course is to give a training to apprentices which will increase their efficiency as mechanics, the method of teaching used and the information given must be adapted to meet this aim. It must be remembered that the average apprentice has a very different type of mind from that of the young man who intends to be a draftsman, since a draftsman should have considerable power of abstraction—a mental exercise which the average apprentice does not engage in to any great degree. The regular course in mechanical drawing, therefore, should not be given to the average apprentice with the idea of increasing his shop efficiency. As in the other courses which follow, special developments of the work are handled in periods varying from one to four months.

General Three-Year Course of Study in Iterpretation of Drawing

First Year

One Month.—Short, simple explanations of the purpose of the course and the value of it to an apprentice. Freehand isometric (or perspective) sketch of a rectangular piece of stock or part used in the shop, drawn from copy without dimensions. Sketch of other rectangular parts drawn from copy without dimensions, later with dimensions. Freehand sketch of parts containing curved lines, using rule for measuring only, black stock, nuts, bolts, washers, rivets, screw threads may be used.

Four Months.—Lettering. Rough pencil sketches of files, chisels, wrenches, various kinds of hammers, appliances, heating furnaces, shape of stock used. Names of parts of tools marked.

Four Months.—Shapes of stock in two views to develop the idea of projection (plan and elevation), also views of stock assembled in two parts.

Three Months.—Sketches of parts of vessels, boats, stock, engines, motor, dynamos and wiring.

Second Year

One Month.—Drawings of simple parts of the machines used in the shop, as pulleys, levers, spindles, gears and cutting heads.

Three Months.—Practice in reading simple blueprints, such as used in the shop: dimension of parts, distance between centers, etc.

One Month.—Drawings of simple parts of machines used in shop involving two views.

Three Months.—Geometrical construction applied to practical work in the shop, such as inscribing hexagon or erecting perpendicular, bisecting angles, reproducing angles, dividing of pitch circle or other problems.

One Month.—Practice in drawing more complicated assembled parts.

Three Months.—Practice in drawing assembled parts, introducing the idea of simple shapes expanding into irregular surfaces.

Third Year

Six Months.—Practice in drawing in ink, tracing and making a blueprint. Drawing of two views of parts of machines. Sectional views.

Five Months.—Practice in making drawings from data or sketches of parts made in shop, and in showing how they are installed.

One Month.—Practice in making drawings of complete machines, or parts of ships, or boats, to show knowledge of working mechanism and construction.

Three-Year Course of Study in Interpretation of Blueprints for Shipfitters

First Year

One Month.—Practice in making rough pencil sketches of nuts, bolts, rivets, screws, washers, taps—isometric plan and elevation views.

Four Months.—Practice in making rough pencil drawings of tools, such as files, chisels, wrenches, various hammers, appliances and metals; heating furnace; oxy-acetylene set; simple plates, rivets in section, angle bars, tee bars, Z-bars, channel beams in two views—to develop the idea of projection. Practice in making drawings to illustrate; rivet spacing, one view of the design should illustrate simple connections, that is, a deck to a bulkhead, bounding bars, in

watertight, non-watertight and oiltight bulkhead spacing; various types of rivets in plates (in section).

Four Months.—Pencil drawings of shapes of tees, I's, and channels. Two-view drawings of bulkheads, bracket plates, hatches, manhole doors, watertight and non-watertight gun ports, hammock berthing, etc.

Three Months.—Drawings of blower foundations; scuttle butt brackets; tank foundations; knee beam connections at decks and floors; hatches and door combings; ammunition stowage; sanitary partitions; companion ways, access trunks, etc.

Second Year

One Month.—Drawings of simple parts of machines, such as pulleys, levers, spindles, gears, cutting heads of planing and scarfing machines. This work will give considerable practice in the use of drawing instruments.

Three Months.—Practice in reading blueprints; distance between centers of rivets, etc. Interpretation of riveting tables. The drawing of floors, intercostals and lines on shell slope of keel. Drawings of keels (vertical, bilge and docking.)

One Month.—Drawing of steel forms of shear blades and parts of joggling machines (two views).

Three Months.—Instruction in the location of parts on plans used in connection with the drawings of combings, stowage; applied geometrical construction—erecting perpendiculars, parallels; reproducing angles and division of pitch circles. Practice in the location of the sea openings of a ship's hatches, gratings, port holes, shell hoists, etc., from use of offsets.

One Month.—Practice in drawing assembled frames, engine foundations, and double bottom sections.

Three Months.—Practice in drawing assembled parts of a ship; frames, lattice work for torpedo bulkheads, cage masts, etc. Location of longitudinals and lines of shell and decks from offsets. Practice in picking bars from book tables. Beginning of the study of simple shapes of expansion on irregular surfaces.

Third Year

Six Months.—Drawing of the bridge ammunition hoist, armored uptakes and views on turrets; work on compartment rearrangement. Locating deck scuppers, boat stowage supports, etc.

Considerable practice should be given at this time in "inking in." All drawings made in the third or last year should be inked, traced and a blueprint made of at least one to illustrate the principle of blue printing.

Five Months.—Practice in making drawings from data or sketches of parts made in the shop. The apprentice should also be taught how to mark the drawings so as to show installation of parts. Transverse and longitudinal drawings from offsets of inner and outer bottoms, bulkheads, location of doors, trunks, etc., through plating and bulkheads, gun port shutters, ship ladders, floors and deck frames, splinter bulkheads; foundations, tanks, boilers, engines, pumps, gun and turret, etc. Drawings of the intersection of objects by planes at angles; as, for example, chain pipe on deck, shell hoist through turret levels, etc. Drawings involving triangulation to lead up to the drawing of developed shell plating.

One Month.—A cross-section drawing through a given frame; a longitudinal section drawing of a ship. This is given to test the apprentice's knowledge of the ship and the use of related plans.

Three-Year Course in English for Shipfitters

First Year

As arranged, one hour a week was allotted to this course.

One Month.—Practice in spelling and description of the various tools, appliances, materials and fittings used in the tool room.

Four Months.—Short oral and written composition work based on the work of the apprentices, such as drilling, reaming, chipping and calking on various parts of the ship (deck platforms, compartments, division, etc.). Description of such terms as section, stern, port, starboard, forward, aft, and after ends of the ship; bulkheads, shell waterline, tanks (oil and fresh water), drainage, etc.; armor plate, cage masts and turrets. This practice will develop the apprentice's power of expression so that he can describe what he is doing in simple and direct English.

Four Months.—Simple principles of grammar relating to the use of nouns and pronouns. Elementary practice in forming sentences so that the apprentice will know when and how to use capital letters and simple punctuation. Composition on trunks, ammunition, hoists, bitts, etc.

Second Year

One Month.—Simple description (both oral and written) on drilling, planing, scarfing machines, on searchlight platforms and cage mast.

Three Months.—Review of the section of grammar relating to subject and predicate to show the pupil that the predicate agrees with the subject. Composition on uptakes, bridges and conning tower.

One Month.—Letter writing and shop order slips. Four types of letters: (1) to a parent; (2) to a friend; (3) to a public official; (4) to a superior official, etc. The four essential parts of every letter should be clearly brought out.

Three Months.—Practice in writing—description of shop work, with special emphasis on the division of the composition into paragraphs. Engine and boiler room foundations, ammunition stowage and boat cranes.

One Month.—Discussion and practice in writing according to the following outline: planning, manufacture and installation.

Three Months.—Composition on the turrets and bulkheads, hatches and armored decks.

Third Year

Six Months.—Considerable practice should be given at this time in both oral and written descriptions. Effort should be made to correct every-day mistakes and develop the power to write lengthy descriptions in simple, direct and concise language. Compositions may cover such subjects as method of propulsion, steering, procedure in building shell of ship, launching, etc.

Five Months.—During this period the apprentice should write reports and descriptions of what he is doing. Emphasis should be laid on accuracy of details in describing the building of a ship—designing, planning, manufacturing and assembling.

One Month.—Written and oral composition on the economical and efficient methods of production.

Three-Year Course in Mathematics for Shipfitters

First Year

One Month.—Practice in solving simple problems dealing with measurements involving four fundamental operations—addition, subtraction, multiplication, and division of whole numbers. Check methods.

Four Months.—Use of fractions and decimals in problems relating to size of taps, drills, time employment, unit costs, tapers, spacing of rivets for single and double riveted seams. Practice in making out bill forms involving percentage and discount.

Four Months.—Problems in finding area of flat surfaces, such as triangular, rectangular, trapezoidal, hexagonal, octagonal and circular forms.

Three Months.—Problems in finding area of irregular surfaces, such as half round, half oval, hollow, channel bar, bulb, angle, etc.

Second Year

One Month.—Problems involving dimension work. Practice in calculating cost of work, which is paid for on the basis of foot thickness. Problems in distributing holes over given areas.

Three Months.—Problems on the fuel calorific values of petroleum, British thermal unit, hydraulic pressure (jogging machines, keel benders), etc.

One Month.—Problems in computing the length of diagonal frames, brackets and braces, involving the use of square root and the solution of triangles.

Three Months.—The use of the formula. Practice in interpreting formulæ and abbreviating rules into formulæ, with previous work as a basis.

One Month.—Considerable training in applied and constructional geometry, such as the erection of perpendiculars, construction of parallel lines, etc.

Three Months.—Locating centers of circles and drawing tangents. Method of finding displacements, draft underloads, and the effect of weight.

Third Year

Six Months.—Use of tables in handbooks on structural steel. Use of graphs and logarithms. The object of this work is to show the apprentice that many calculations may be shortened by the use of short cuts and logarithms.

Five Months.—Theory and practice of the slide rule, which involves a knowledge of logarithms. Considerable practice in manipulation of the rule.

(*Concluded on page* 178)

Fig. 1.—Plant of the General Shipbuilding Company, Inc., Alexandria, Va.

Manufacturing Standardized Lifeboats

Quantity Production by Automobile Manufacturing Methods—Number of Sizes Reduced — Parts Made Interchangeable

BY MORRIS M. WHITAKER

UP to the time that the Emergency Fleet Corporation came into the market to supply the requirements of its shipbuilding programme, lifeboats had been built, one may say, almost as individuals. The few companies which specialized in them were, with one or two exceptions, small, and had no facilities for production in quantity, nor had they room or capital for expansion.

Each company had been in the habit of building an extended list of sizes, and each had its own models and specifications. In one instance, a company built fifteen sizes. The situation was further complicated by the fact that the rules of the United States Steamboat Inspection Service required a type of steel a little higher than the commercial grade, and also that the steel entering into the construction must be tested. Further, the gage called for was not the one used commercially, and few of the steel companies cared to roll this special stuff when the volume of business was so small.

Production Capacity of Lifeboat Builders Limited

Under conditions such as these, the Emergency Fleet Corporation found it extremely difficult to place large orders, for the difference in the specifications of the boats offered made it almost impossible to decide between the actual value of the boats and the diversity of model complicated the installation on the ships. However, as the necessity was great, the Emergency Fleet Corporation placed orders for all the boats the various companies could take and loaded them up for months ahead. Luckily the demand was not for immediate delivery and this gave the various companies with orders a chance to obtain material, which, however, was slow in delivery, and at times the Fleet Corporation was hard pressed to get the necessary lifeboat equipment for ships fitting out.

The Fleet Corporation early realized that here was an excellent field for standardization and set about getting out its own plans and specifications. When these were complete it was in a position to order in a quantity which would permit of manufacture.

First of all, in getting out its plans and specifications, it was necessary to reduce the number of sizes, which was finally cut to five, built to the following lengths: sixteen, twenty, twenty-four, twenty-six and twenty-eight feet. The gage of metal for shell plating was reduced to two sizes and these were made to correspond to the United States standard. Parts and fittings were made interchangeable between the sizes in so far as this was possible under the Steamboat Inspection Service rules. For instance, the gunwales of certain sizes were interchangeable, sails were made so that two sizes covered all five sizes of boats, three sizes of tanks served all five sizes of boats, and all these were made cylindrical instead of shaped, thus saving material and labor. The different sizes of oars required was brought down in number, and the outfit required by the rules was made standard for all sizes. The sizes of sheets for plating and tanks were standardized, which permitted a considerable saving in ordering. The Emergency Fleet Corporation ordered this in quantity from the manufacturers and distributed it to the builders. In this way the cost of the boats was brought down, in spite of the increased cost of both material and labor, and a greater production was made possible. This procedure also simplified the work of the shipbuilder in installation of boats and davits and gave him boats in anticipation of his requirements.

Quantity Orders Given to New Companies

With the establishment of its standards, the Emergency Fleet Corporation placed a number of quantity orders with companies not heretofore doing this class of work. Among these was the General Shipbuilding Company, Inc., Alexandria, Va., which was organized at about the time the United States entered the war and which had built a number of submarine chasers for the Navy Department.

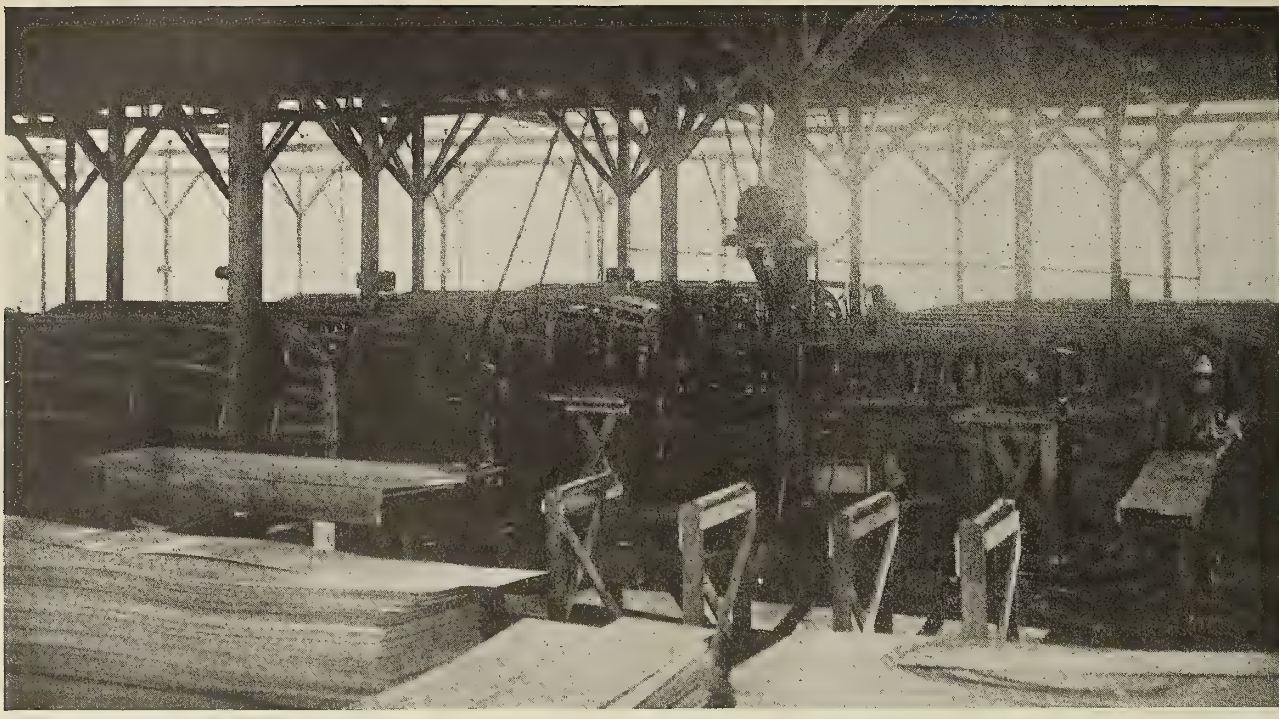


Fig. 2.—Molds on Which the Lifeboats Are Shaped

This company immediately set about building a plant for this special work and went into the matter thoroughly from a manufacturing standpoint. A part of its property, formerly used for lumber and timber storage, was cleared, graded and leveled and a building 224 feet long and 165 feet wide, with 18 feet clear head room, was erected. The plant was laid out east and west, with five bays or runways and a lean-to for storage along the south side. Each bay or runway was wide enough for the construction of two boats, side by side. This allowed work on ten boats at the same time.

Layout and Arrangement of General Shipbuilding Company's Plant

Machinery for cutting the plating, punching and bending it was installed in the southeast corner, with other tools, racks, molds and fittings extending across this end to the northeast corner. Ten building or forming molds were installed, extending across the building from north to south. The process of manufacture is progressive from east to west through the building. Each boat moves at each operation or series of operations, starting as a bare keel at the east end and coming out as a completed boat at the west end. At the west end of the building is a switch track extending across the whole length of the front, with a three-leg derrick at the southwest corner for unloading material and loading completed boats.

Work on the boats was started before the building was completed. Construction work on the building began at the south side and worked across, so that the boats were actually completed in the south bay before the last bay on the north was closed in.

In the manufacture of boats the system used is as follows:

System of Manufacture

Materials of all kind come in at the switch track. If they are such as require no further manufacture, they are shifted from the switch track by a light railway, running along the south side of the building, to a point in the lean-to storehouse nearest to the operation where they are to be used. If they require manufacture, they are shifted by the light railway to the point of manufacture. Thus, steel for plating goes to the extreme southeast corner, close to the cutters. If the material is for keels, it is carried by another light railway to the northeast corner, where it is bent, punched and otherwise prepared to go on the keel molds. If the material arriving is lumber, it is unloaded farther south on the switch alongside the company's mill, and when worked to the form of completed parts, it is carried across the yard to the lean-to storeroom by another light railway and deposited at the point most convenient for its use in the progressive manufacture.

Process of Construction

In the actual construction of the boats the process is as follows:

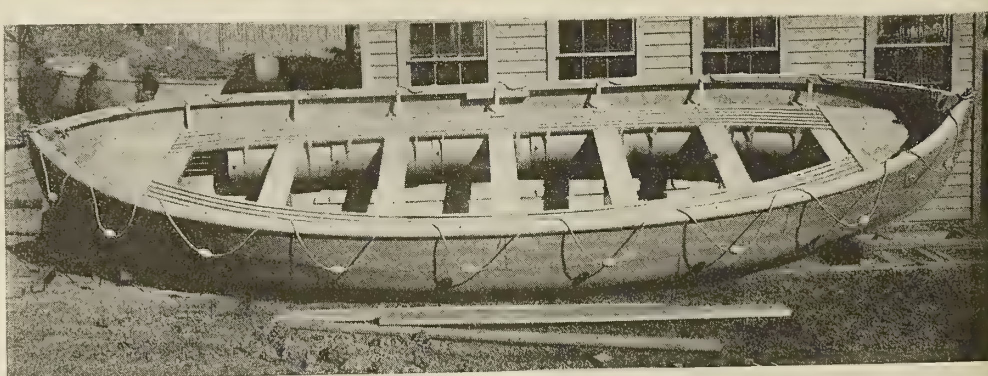


Fig. 3.—Completed Emergency Fleet Corporation Standard Lifeboat Ready for Shipment

Fig. 4.—View in One of the Runways, Looking Across the Shop

The steel for the plating is stored at the southeast corner, each size in a pile by itself. The different strakes and plates are marked from steel templets and start north across the end of the building. First they pass through the cutters, from these to the gang punches, then to the storage racks for plates, ready to use, located near the center of the east end.

Material is Brought to the Workmen

The bar for the keel comes into the northeast corner, where it is bent, punched, and the brackets for the dropping gear are riveted on by air hammers. It is then picked up by an overhead conveyor and put on one of a set of molds at a convenient height for the forming and riveting of the garboard strake.

This strake of plating is taken from the racks and formed by breaks and rolls, conveniently located, and attached and shaped to the keel, to which it is riveted by air hammers. It is again picked up by the overhead conveyor and, through a system of switches, placed on a vacant mold, where the plating is completed.

Each plate when it leaves the racks is punched on one side and one end. As the plating of the boats is lap strake, the unpunched edge of the seam is punched by hand and riveted to its adjoining plate at several places to hold it in position. As soon as the plating is completed, the boat is removed from the mold by the overhead conveyor and shifted ahead about its own length and turned over.

The next step in construction is the installation of the gunwales, previously prepared, so as to stiffen up the structure sufficiently to permit of punching the remaining rivet holes and riveting them up. The boat is then again moved down the shop for the punching of the bottom and sides for the installation of the toggle straps for the footings and the U plates for the thwarts.

Other steps in the manufacture of the boats are installation of dropping gear, placing of footings, thwarts, side benches, end platforms, tanks and painting and installing gear and outfit. At each step or combination of steps the boat is moved down the runway to the west, and by the time it arrives at the west end of the runway it has been inspected and is ready for shipment.

Each operation or series of operations is timed for a working day, and a sufficient number of men to put it through in this time are assigned to this work. These gangs of men do one operation only and then pass the boat along to the next gang. Materials for each operation are located in the lean-to abreast the operation and travel across the shop, messengers being used for this work so that each man has his material brought to him at the point where he uses it.

Each part of the boat is made to a master templet and is carefully inspected before going into the finished material store, with the result that there is little or no fitting to be done in the progress of the work. The product is remarkably uniform in quality.

Output of the Plant

In general, a boat is started each morning on each mold and one is finished each night at the shipping door of each bay. The period from putting the keel on the mold to shipment averages about four days, although this varies somewhat with labor and material conditions, for the absence of a few workers in the different operations, or the lack of some part, due to railway conditions, upsets the smooth flow of production.

When working all bays on one size of boat, the annual capacity of this plant is about 3,000 boats per year, without any overtime. If working on varied sizes, this production would be cut somewhat. At present, daily shipments are being made by rail and an occasional shipment by water.

New Edition of Aldrich Marine Directory Issued

The 1919 edition of the Aldrich Marine Directory, just issued by the Aldrich Publishing Company, New York (price, $5), contains 230 pages, 4½ by 8¼ inches. The directory contains lists of concerns which build and repair vessels in the United States, and also of steamship, steamboat and other vessel owners operating ships under the American flag. The shipbuilders' list comprises nearly 500 shipbuilding or repair yards, which have a total of nearly 2,000 launching ways and about 400 drydocks and marine railways.

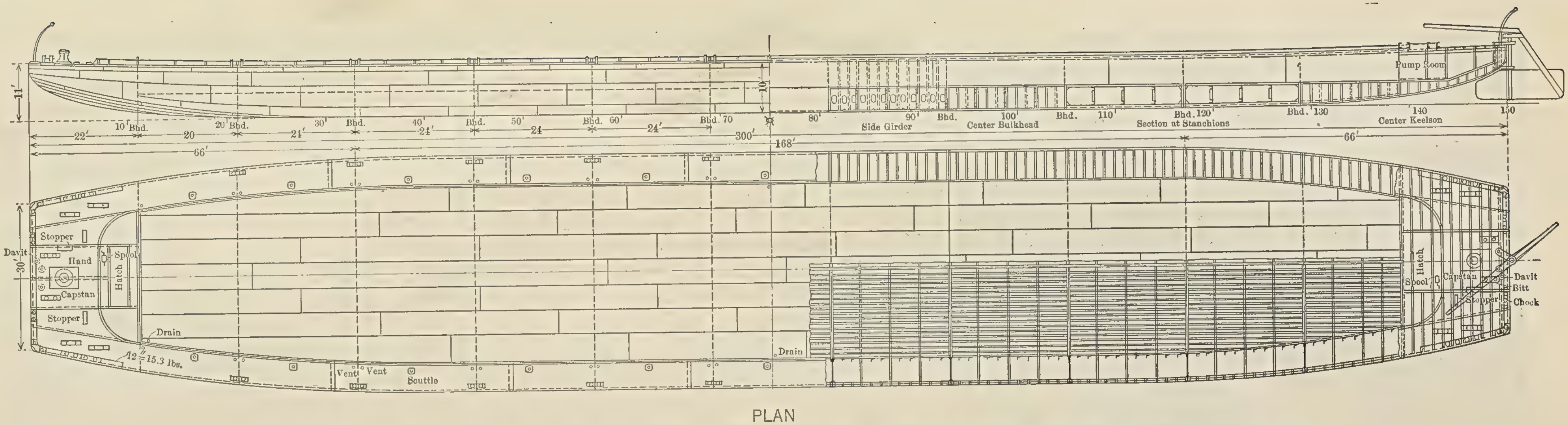


Fig. 1.—General Plans of Upper Mississippi River Open Hopper Type Barge. Length of Hopper, 256 Feet; Width of Hopper, 36 Feet

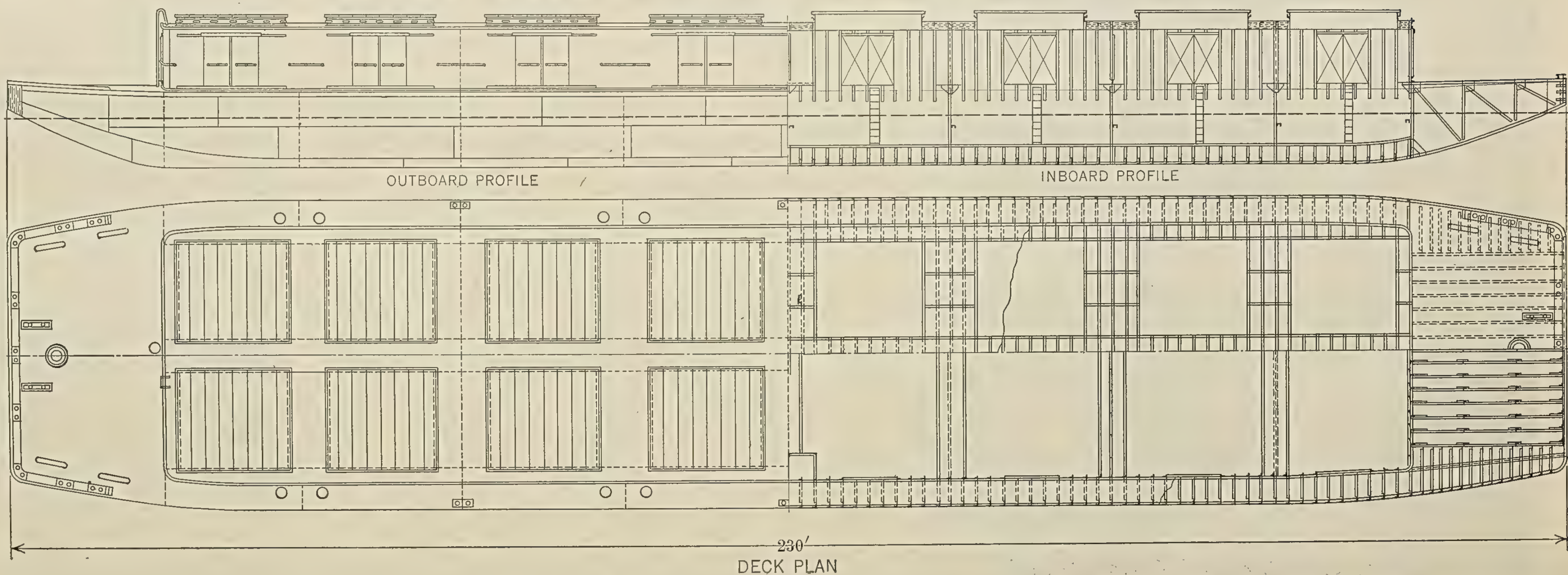


Fig. 2.—General Arrangement Plans of Cargo-Box Type Barge for Lower Mississippi River Route. Length, 230 Feet; Beam, 46 Feet; Depth, 11 Feet

Revival of Mississippi River Traffic—II

Towboats and Barges of the "Upper" and "Lower" Mississippi River Fleets—Plans and Details of Construction

BY M. VON PAGENHARDT*

THE nineteen river barges for the "upper fleet," as the St. Paul-St. Louis iron ore fleet begins to be called, in comparison with the "lower" or St. Louis-New Orleans fleet for general freight transportation, are of the open hopper type. The main deck is sunk to a point halfway between the deck and the bottom of the barge, leaving a deck stringer of 6-foot width on either side of the hopper. The hopper is 256 feet long (85 percent of the length of the barge) and 36 feet wide. One watertight center keelson and two side keelsons provide longitudinal stiffness, and twelve transverse bulkheads, spaced 24 feet apart, provide sufficient transverse strength. There are, altogether, twenty-four watertight compartments.

A complete oil pipe and bilge system is arranged both for filling and emptying the barge, in case fuel oil is carried in the double bottom. For this purpose a 10-inch by 10¼-inch by 12-inch duplex horizontal steam pump is installed in the pump room, together with a 6-inch by 6-inch double barrel beam hand pump. Oil filling and discharge pipes, as well as steam connections, are arranged on deck on either side of the barge.

In order to permit towing on a line and in either direction, each barge is equipped with two detachable rudders, one at each end of the barge. When in tow, the tiller-line is taken around the capstan, which is designed to work in either direction. The deck equipment includes two 2,000-pound stockless anchors, a special design of cable-stopper mounted on a turntable, cable reels, anchor davits and fenders. In order to insure absolute "watertightness" under all conditions, all deck openings are closed with watertight hatches, and the oil vents are of the self-closing type, in case the deck coaming should be under water.

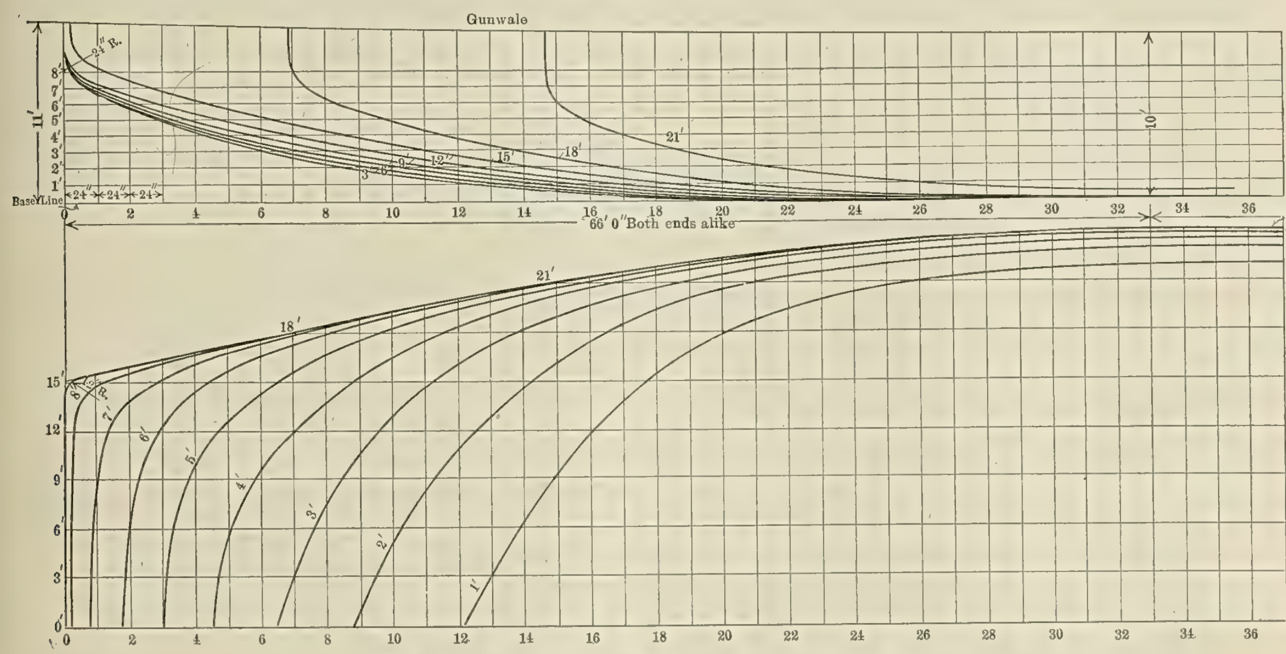


Fig. 3.—Molded Lines of Upper Mississippi River Barge

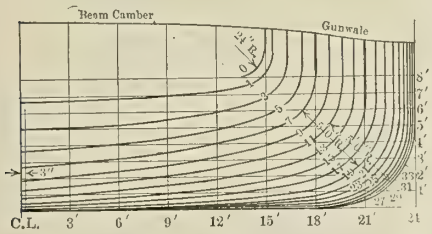


Fig. 4.—Body Plan of Upper Mississippi River Barge

The contract for the nineteen steel barges was given to three contractors, six to the Dravo Contracting Company, of Pittsburgh; seven to the Dubuque Boat & Boiler Works, of Dubuque, Ia., and six to the Marietta Manufacturing Company, of Point Pleasant, W. Va. The contractors were required to submit a uniform bill of material and guarantee a uniform method of construction. To carry this out, they retained the services of C. E. Smith & Company, naval architects and consulting engineers, of St. Louis, to make the detail drawings.

Uniform Rivet Spacing

Instructions were given to lay out the work for multiple or rack punches. It was planned to fabricate the straight part of the barges, which covered almost three-fifths of the total steel weight of 500 tons, in outside structural mills. Since these mills were inexperienced in barge work, details had to be made for each plate. It was found that equal rivet spacing for the entire length of seams and butts was not possible, if the different conditions covering "watertightness" and strength of seams and butts, crossings of adjoining laps, frames and bulkheads were properly observed in accordance with the rules of the American Bureau of Shipping and the Government specifications. It would have been desirable, for example, to space

*Naval architect, St. Louis, Mo.

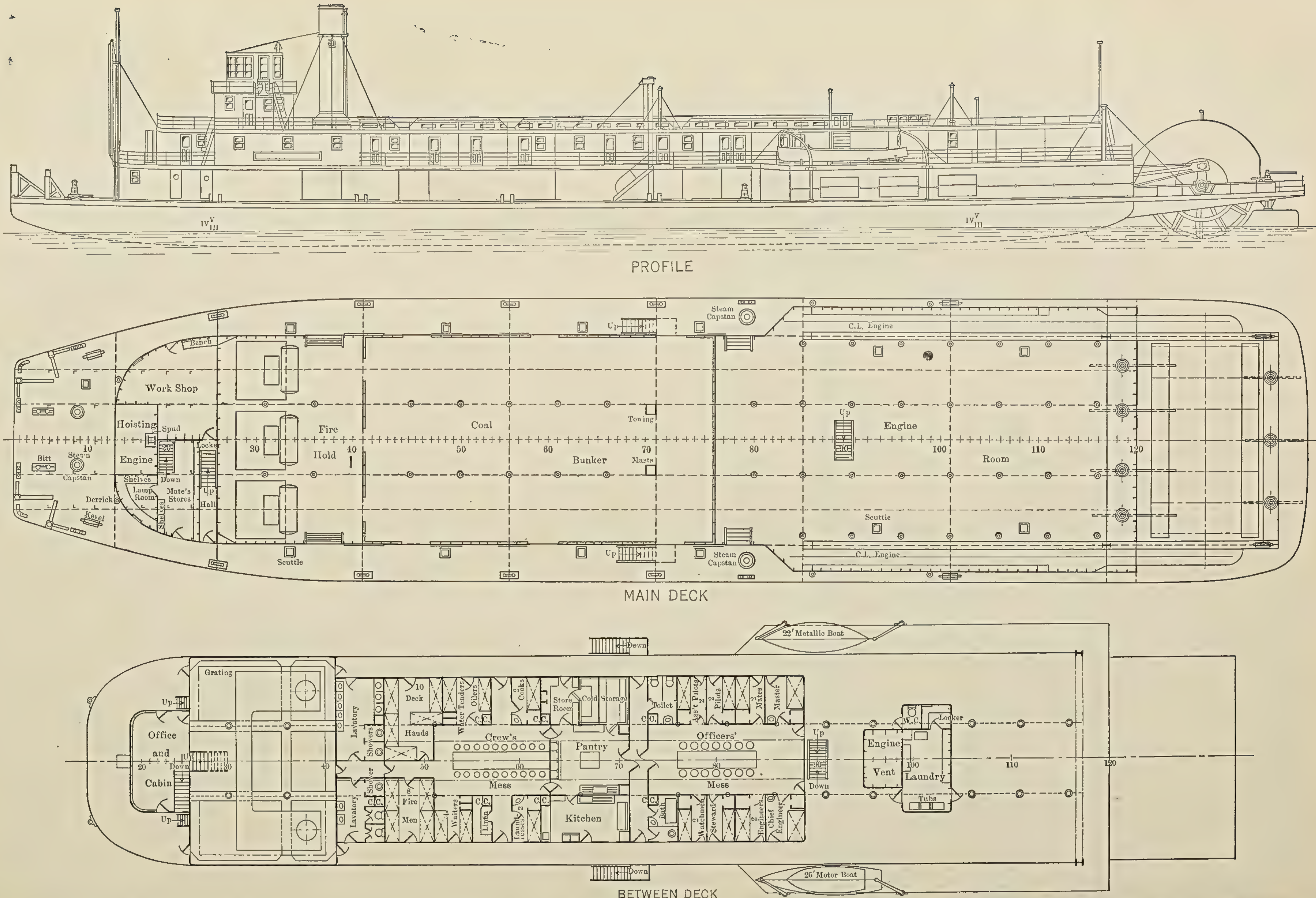


Fig. 5.—Upper Mississippi River Steel Towboat. Length Overall, 265 Feet; Length Between Perpendiculars, 230 Feet; Beam, 58 Feet; Depth, 8 Feet; Displacement, 945 Tons at Minimum Draft of 3 Feet; Indicated Horsepower, 1,600

all rivets on the 24-inch frame in equal distances of 2.4 inches, that is, ten spaces to the total length. But as the specifications called for 2¼-inch rivet spacing for ⅝-inch rivets and 5/16-inch plates, and as all butts had to be triple riveted, a uniform "panel" spacing was adopted instead of a uniform "rivet" spacing. All panels were spaced equally—ten spaces of 2⅛ inches and one space of 2¾ inches, making the total of 24 inches.

Wherever possible, uniform spacing was adopted in seams and butts, and odd spacings of 1⅞ inches or 2⅞ inches were changed to equal spacings of 2 inches and 3 inches, respectively, wherever an increase in the efficiency of the butt was desirable. To insure uniform spacing of rivets in frame and gunwale angles, a system was evolved which would make all spaces from 1 foot up to 23 feet identical, so that the mold loft work and the work of supervision were greatly simplified, inasmuch as only a limited number of master templets was required, and all equal distances had equal rivet spacings throughout the length of the vessel.

Great care was observed in the bill of material. A large part of the structural shapes, particularly the channels, were ordered the exact length, in order to save cutting at the yard. The same care was used in the laying out of the pipes and fittings of the complete oil pipe and bilge system, and in planning the fire steam smothering system, so as to reduce the cost of material and of special labor to the minimum.

Upper River Towboats

The four new upper river towboats are of the stern paddle wheel type. The dimensions are 230 feet from stern to transom; 58-foot beam and 8-foot depth, displacing 945 tons, with a minimum draft of 3 feet. The length overall is 265 feet, including the stern wheel and the stern guards protecting the auxiliary rudders.

The design is an evolution of the old-fashioned stern-wheel towboat, retaining its well-proven good features, but otherwise following strictly the principles of modern naval architecture and mechanical engineering. The hull is designed as a structural unit, including the heavy stern-wheel overhang. Instead of supporting this weight by hog chains and king posts, the necessary stiffness is provided by running the sides of the deck house past the stern-wheel shaft supports and by reinforcing the middle or between deck so as properly to take care of the longitudinal stresses. The distribution of the weights, by placing the wheel and machinery aft and boilers and coal forward, produces considerable static stresses. Immeasurably higher, however, are the dynamic stresses produced by the working of the wheel, particularly in grounding the vessel.

The main engines are designed to develop 1,600 indicated horsepower at normal working load with a 20 percent overload capacity, and the power is absorbed by a stern wheel 22 feet in diameter and 42 feet long, having only twelve buckets 3 feet 6 inches wide. A thrust of

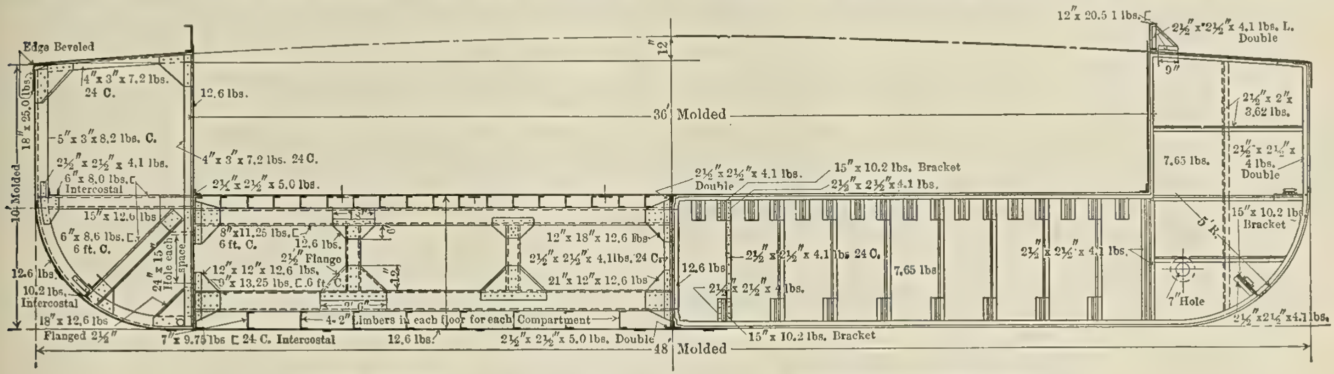


Fig. 6.—Midship Section of Open Hopper Type Barge for Upper Mississippi River Route

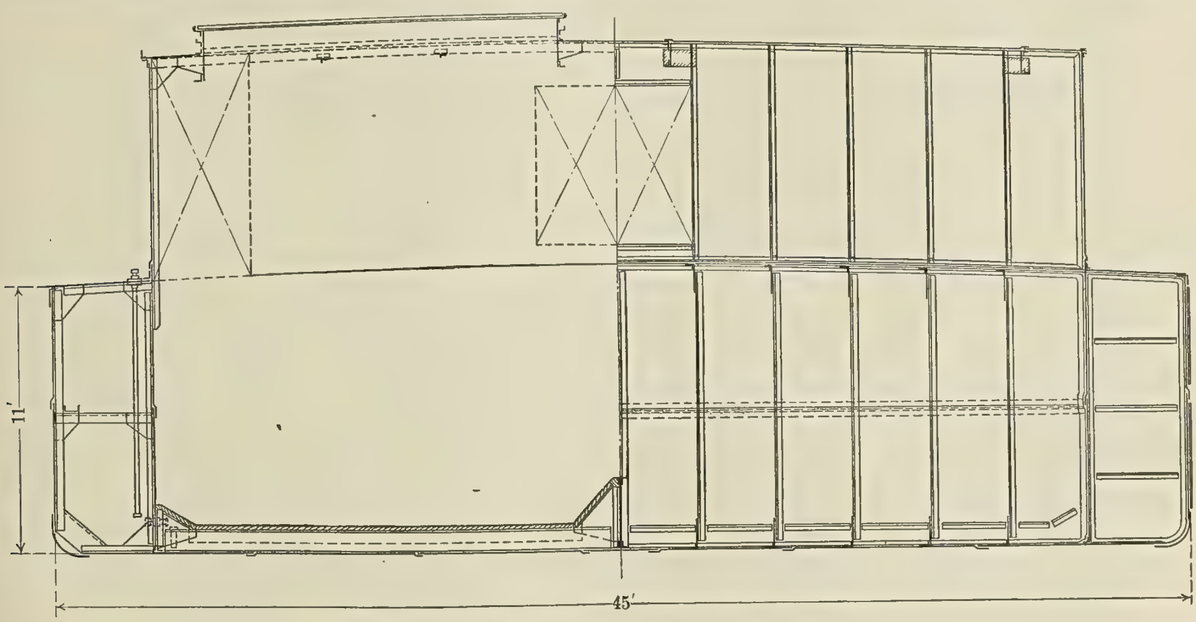


Fig. 7.—Midship Section of Cargo-Box Type Barge

50,000 pounds is required in a dock test with a mean speed of 12 miles per hour, running with a draft of 4½ feet. The engines are of the tandem compound type, 24-inch high pressure, 50-inch low pressure and 8-foot stroke, designed for 250 pounds pressure and 24 revolutions per minute. A double set of pitmans, crossheads and slides are arranged to bring the heavy machinery weight well toward the center of the vessel. A circular steel shell condenser with cast steel heads and 3,600 square feet of cooling surface, together with circulating and air pumps, is mounted abreast the low pressure cylinders.

Boiler Equipment

The boiler battery is either of the straight watertube or the combination fire and watertube type, capable of evaporating 50,000 pounds of water per hour. The battery was designed for the use of Illinois bituminous coal, having large furnace room. The total heating surface is required to be not less than 10,000 square feet, including

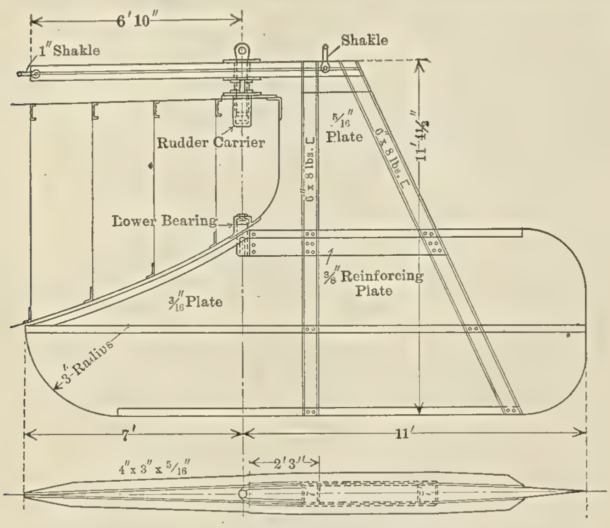


Fig. 8.—Details of Rudder of Upper River Barge

superheaters capable of 75 degrees superheat and feed-water economizers capable of raising the feed water to at least 350 degrees F. Both forced and induced draft are to be installed under each boiler.

Engines for Upstream Towing

The deck machinery includes four capstans, one winding engine placed on the forward deck—capable of 100 tons pulling capacity—two towing engines placed on the boiler deck, handling ⅞-inch hawsers, six conveyor units for handling coal, spud-raising machinery, and electric generators for day and night service.

The introduction of towing engines is expected to prove of greatest value in handling the tow on the upstream voyage. The method of towing barges on a line is not expected to be used in downstream work, but having proved so advantageous elsewhere in upstream towing, mounting rapids and maneuvering through locks, the towboats are properly equipped with engines carrying 1,500 feet of hawser, and the wheel, cranks and pitmans are entirely enclosed to facilitate the handling of the tow. Naturally, the boats are equipped with the well-proven auxiliary rudders aft of the stern wheel.

The auxiliary machinery includes ballast and bilge pump, domestic pump, exhaust steam feed-water heater and evaporator, steering engine, ice machine and air compressor. The outfit includes one 26-foot motor boat, with a speed of 12 miles per hour, one lifeboat, one work boat with detachable 5-horsepower motor, and all necessary lines, hawsers, chains, tools and spares.

Accommodations are provided for a crew of thirty-four officers and men.

Particular care has been given to the attainment of maximum power with minimum displacement and minimum draft. The accomplished result, 1,600 to 2,000 indicated horsepower on 945 tons displacement, or about 2 indicated horsepower per ton, is at least 50 percent superior to any towboat power applied to date on western river stern-wheel towboats.

Lower River Barges

The forty steel river barges of the "lower" or merchandise fleet, to operate between St. Louis and New Orleans, are 230 feet long, 46 feet wide and 11 feet deep. Contract has been let for twenty-five of these barges to the American Bridge Company, of Ambridge, Pa., and for fifteen to the Dravo Contracting Company, of Pittsburgh, Pa. The original plans and specifications called for all-steel merchandise barges of the cargo-box type with sunken deck construction, similar to the upper river barges, but differing in the form of the ends.

Instead of adopting the modified form of the scow with sides well drawn in and well-shaped bilges, in accordance with recommendations of the United States Experimental Towboat Board for upstream towing, the designers, Cox & Stevens, of New York, adopted the simpler form of straight scow, possibly as a compromise to the builders. The additional resistance of this form of barge over the resistance of the modified form on the 1,200-mile upstream haul will, in the writer's opinion, be a most serious handicap in the ton-mile capacity, as the earning capacity of the barges for their entire life is based upon that factor.

As an additional compromise, the sunken steel deck was later dispensed with by request of the War Industry's Board, in order to save 20 percent of the required steel. As a substitute, a yellow pine floor was ordered to be laid directly on the floors. This action automatically excluded the possibility of carrying fuel oil in bulk in the double bottom, and also did away with the oil pipe and bilge system required for the discharging and filling of the hold compartments. The declaration of the armistice should have altered the underlying necessity for the War Industry's decision.

The writer understands that action has been taken to replace the steel material for the wooden floor, thus restoring the double or sunken deck construction. River barges should be built with the same care and foresight as ocean-going ships. Negligence in construction accounts for the greater part of the losses in river floating equipment.

Lower River Towboats

The six new lower river towboats are of the twin tunnel screw type. The dimensions are 200 feet overall, 40 feet wide and 10 feet deep, displacing 1,050 tons with a draft of 6 feet. The design is an enlargement of the tunnel towboats *L. A. Rumsey, A. M. Scott, Inspector* and *Claireton*, all built by the Ward Engineering Works, of Charleston, W. Va. The contract for the building of two of these vessels has been let to the Charles Ward Engineering Works, and, for the other four, to the Marietta Manufacturing Company, Point Pleasant, W. Va.

The design, which was made by Cox & Stevens, of New York City, acting for the United States Railroad Administration, embodies the suggestions of the experienced tunnel boat builders, the Ward Engineering Works.

The steam power of the vessel is named as 1,800 indi-

cated horsepower, which is absorbed by two screw propellers 9 feet in diameter and of 9-foot pitch. As the vessel is permitted a draft of 6 feet, two-thirds of the screw is fully submerged, which is fully in line with the experience gained on other vessels of this type. The two main engines are, according to the contractor, of the standard Emergency Fleet Corporation pattern, developing 700 indicated horsepower, with 150 revolutions per minute. The engines are expected to develop 900 indicated horsepower each, when turning 190 to 200 revolutions per minute, the piston speed in this case—with cylinders of 26-inch stroke—being 870 feet per minute, which is relatively high.

The boiler battery is of the straight watertube type as built by the Ward Engineering Works, with a heating surface of 8,000 square feet, fuel oil being used as fuel. Superheaters and feedwater economizers are not specified. The capacity of the boiler battery is required to be 32,000 pounds, with an overload factor of 25 percent, bringing it up to a total of 40,000 pounds.

The auxiliary machinery includes a surface condenser of 2,400 square feet, with all circulating, air and feed pumps, a fire pump, a bilge and ballast pump, sanitary pumps, and steering engine. The deck machinery includes four steam capstans and two electric generators.

The selection of the tunnel screw boat for the entire six towboats of the lower river division—St. Louis to New Orleans—in preference to the stern-wheel towboats, is looked upon with some misgiving. Ths tunnel screw towboat is unqualifiedly entitled to recognition. There is at this time in service the *A. M. Scott,* a boat of 600 indicated horsepower ,and the *Claireton,* a boat of over 1,000 indicated horsepower. These boats have proved equal to any stern-wheel towboat of the same power, both in push and in handling ability. They are operating on a draft of 3½ and 4½ feet, respectively, turning twin propellers of 60 and 80 inches diameter.

There is, however, a certain amount of experiment attached to the tunnel type towboat of still larger power, inasmuch as a twin screw tunnel boat of 1,800 indicated horsepower has never been built before. On the other hand, there is absolutely no question about what a stern-wheel boat of such power will do, and that it will be satisfactory in push and handling ability even without the improvements introduced in the upper river towboats.

(*To be concluded.*)

Marine Diesel Oil Engine Problems—II

Discussion of Probable Size of Diesel Engines—Methods of Balancing—Construction of Mufflers—Cooling Systems

BY JOHN W. ANDERSON

There is one difficulty with the gravity lubrication and the mechanical oiler, and that is, that there are nany parts and pipes to consider, and each pipe or lead requires a certain amount of individual attention in order to see that the proper amount of oil is being supplied to that particular part. Furthermore, with these systems only just enough oil with a slight margin is provided to cover the necessary requirements of the bearing.

The big advantage of the forced lubrication system is that a good surplus is supplied to each bearing at all times and distribution of the oil is secured by the proportions of the various passages, and hence requires no attention on the part of the operator other than to make sure that the main supply to the engine is kept up. Of course the various passages must be kept clear and open, but this is a matter that can be readily attended to during the overhauling period and there is very little tendency for the oil to plug up the passages during operation.

There is one thing in connection with forced lubrication that is extremely important and requires constant watchfulness on the part of the operator, and that is the question of salt-water leaks into the lubricating oil. Any leak into the crankcase, no matter how small, forms an undesirable mixture with the lubricating oil and at moderate temperatures creates a deposit which will quickly plug up the passages. If special precautions are taken against the leakage of the salt water into the oil and the condition of the oil is watched carefully at all times, there is little chance for difficulty in this direction. From every other standpoint forced lubrication has the advantage over other methods. The proof of this is best shown by the increasing adoption of this system on engines of all types and sizes.

With an open-frame engine, and using special precautions so that lubricating oil from the working cylinders does not drip into the crankcase, the oil does not become foul except after long service, but with the closed-crankcase trunk-piston engine the lubricating oil soon becomes fouled with finely divided carbon particles. After a time the oil turns very black and viscous and tends to clog the oil passages. This requires as much as 3,000-hours' running in some cases, while in others this condition obtains in a few hundred hours. It is understood, of course, that oil is added from time to time to make up for the losses, but the system is not cleaned out and the whole supply replenished in all this time. As this condition of the oil is approached, the danger of bearing troubles increases, and if it can be voided the oil ought never to be allowed to get into such a condition.

Most of the carbon particles are removed by filtering and the filtered product approaches the original in all its properties, except that it is darker, due to the presence of the particles which were not removed by filtering. The centrifugal process of clarifying is even better than filtering and removes a larger proportion of the carbon particles.

To attempt to filter or clarify the oil each time it is circulated through the engine would imply the addition of too much apparatus to take care of such a quantity of oil, and fortunately it is unnecessary. The best way is to drain out the system at regular intervals, depending upon the type of engine and the conditions of the service, and fill up with fresh oil. The fouled oil can be filtered at leisure and kept for future use.

Size of Diesel Engines

The Diesel engine industry is still so young that the question of how large an engine can be built is one that cannot readily be answered at this time. Practically all

of the engines in service to-day are of small and moderate power as compared with certain steam plants, but, on the other hand, big strides have been made in the last few years in the development of large units. The largest two-cycle marine engines in actual operation to-day are the two engines in the U. S. S. *Maumee*. These engines develop more than 2,500 horsepower in six cylinders, or about 425 horsepower per cylinder.

In the marine field there are very few four-cycle engines which even approach the cylinders of these engines in size, which means that the actual horsepower developed is much less than for these two-cycle engines in the *Maumee*. It must be remembered that these particular engines were designed four years ago and now have been in operation long enough to show that they are an unqualified success. The troubles developed with them have been of a very minor nature and are largely due to the lack of sufficient experience with this size of engine. New engines of a similar type and size could be built to-day and no trouble whatever would be expected with them. By trouble is meant something beyond the ordinary care and overhaul which any piece of machinery requires. The successful operation of these engines indicates that all ships requiring 5,000 shaft horsepower or less, and this will include practically all ocean-going vessels built for cargo-carrying purposes, can be successfully equipped with Diesel engines.

Several European firms have experimented with single-cylinder units of approximately 2,000 horsepower per cylinder, but, so far as is known, these engines have never gotten beyond the experimental stage, probably due largely to the present war, which has undoubtedly retarded the development of large engines. Large double-acting, four-cycle stationary units have been in successful operation in Germany for several years. These engines have been built up to a size of 500 horsepower per cylinder. The *Maumee's* engines, if made double-acting, would develop over 800 horsepower per cylinder. In view of what has already been done and the experimental work that has been undertaken by so many firms, it is undoubtedly only a question of time when Diesel-engine power will be available for all except the very fastest liners and warships.

Balance

The vibration produced by an engine depends largely upon the number of cylinders and upon their arrangement. In commercial work, generally speaking, the speed is slow enough and the hull heavy enough, so that the matter is not one of great importance, but in the case of a high-speed engine in a light hull it is absolutely necessary that the engine be properly balanced.

For commercial work many four-cylinder, four-cycle engines have been built, and these engines are very badly out of balance, due to arranging the cranks all in one plane to get the best turning moment. But, as already stated, where these engines have been installed no serious difficulty has resulted, due, undoubtedly, to the relatively low revolutions and the small size of the engine as compared with the hull.

If good balance is desired, it is necessary to use six or eight cylinders, which can be made to give the best turning moment and a good balance at the same time. The only thing that interferes with giving these engines a perfect balance is the air-compressor cylinders, but the reciprocating parts of these compressor cylinders are comparatively light and hence do not cause any serious difficulty. In the case of crosshead engines it is oftentimes convenient to drive the compressors by beams and links from the crossheads. On a six-cylinder, four-cycle engine, for instance, there might be three compressors driven from three of the cranks, or on a six-cylinder, two-cycle engine three compressors would be driven from three of the crossheads and three scavenger pumps from the other three, so that a practically perfect balance would be obtained.

Fuel System

The usual method for the fuel system is to carry the main supply of fuel in the double bottom or in tanks in parts of the ship that are not ordinarily otherwise used, and then provide pumps for pumping it into gravity tanks placed well up in the engine room so that the fuel can flow by gravity from the tanks of the engines. The tanks are made large enough to hold at least several hours' supply and oftentimes a whole day's supply, so that the fuel has plenty of time to settle and any sediment or water will collect at the bottom of the tank, where it may be drained off. It is very necessary that the fuel supply to the engine be perfectly clean. Very small particles of dirt or foreign matter will stick in the valves on the fuel pumps on the engine and cause no end of trouble. There is only one way to avoid getting this dirt into the engine, and that is to filter the fuel properly. The filter is sometimes placed between the gravity tank and the engine and is sometimes combined with the gravity tank. In case the gravity tank is of small capacity, it is generally placed on the discharge side of the pump, which pumps the fuel from the main tanks to the gravity tank.

The arrangement of the exhaust piping depends upon the type of the boat and the conditions of the installation. In the case of small boats where the waterline is more or less fixed and very little rough water is encountered, an underwater exhaust works out very satisfactorily, but in the case of large ships the exhaust must be carried up a stack. In twin-screw boats it is essential that the exhaust from each engine be kept separate so that it can be watched by the operators. One of the simplest methods of detecting faulty operation in a Diesel engine is to watch the exhaust. The least sign of smoke is a sign of poor combustion and should be investigated at once.

Mufflers

Many varieties of mufflers are used. The main idea of all of them is to break up the pulsations in the flow of the gases and give a steady flow. Where there is plenty of space and weight available, a big expansion chamber serves fairly well, but it is much better to reduce the size and use baffle plates. One of the best types is one in which the gases enter a cylindrical chamber tangentially at the circumference and escape at the center, or vice versa. Cooling the gases by turning the cooling water from the engine into the exhaust pipe helps, too, but is not used except in some special cases. If there is very much sulphur in the fuel, water combines with the products of combustion and forms sulphuric acid, which will in time destroy the exhaust piping. If, however, the entire quantity of the cooling water passing through the engine is turned into the exhaust, the mixture is so diluted that there is little danger of trouble.

The piping itself must be jacketed or lagged and due allowance must be made for expansion. Water-jacketing is in most cases more satisfactory, but it adds to the complication and cost of the system and for that reason is oftentimes avoided and the pipes are lagged.

Many ships have been fitted with boilers or heaters for using the waste heat in the exhaust gases. No great quantity of high-pressure steam can be produced on account of the comparatively low temperature of the exhaust gases. At full power this temperature is around 700

and 800 degrees F., but at ordinary sea speeds this temperature drops to around 600 degrees F. or even less. This is particularly true of naval vessels where the maximum speed is considerably higher than the cruising speed, and hence the exhaust temperature may drop as low as 400 degrees F. when cruising. However, there is considerable heat available. Speaking broadly, the heat given off in the exhaust gases is about equal to the equivalent useful work done by the engine. This heat can best be used for the production of low-pressure steam for heating purposes. To take care of conditions when the engines are stopped, a fuel-oil burner can be fitted to the boiler and the same fuel used directly in the burner as is used for the engines.

Cooling System

The question of cooling the various parts of a Diesel engine is an important one, but as far as the fixed parts are concerned the problem is simple for all ordinary sizes of engines. It is only necessary to provide for the proper flow of the cooling water, avoiding all pockets and dead areas. In the case of nearly all two-cycle engines and in four-cycle engines of quite moderate size, it is necessary in addition to cool the working piston, and herein lies a real problem. There is no exact dead line below which cooling is unnecessary and above which cooling is necessary, as a great deal depends upon the conditions of operation; that is, a high-speed engine designed to be driven at a heavy overload might require cooling, while the same engine driven at a lower speed and moderate power would operate perfectly satisfactorily with uncooled pistons. It is simply a question of carrying away the heat absorbed by the top of the piston. If it can be carried off fast enough through the cylinder walls to keep the center of the piston head from getting too hot, then the pistons do not need to be cooled, but if this is not so, then the extra heat must be absorbed by the circulation of a cooling medium through the piston. In general, it may be said that two-cycle engines developing 50 brake horsepower or more per cylinder and four-cycle engines developing 150 brake horsepower or more per cylinder are better off with cooled pistons.

The difficulties in the way of successfully cooling the piston are best shown by the variety of substances used and by the various devices employed to carry the substance to and from the piston. The simplest method is to employ a jet of air, but this is not very effective and can be used only where the cooling effect required is very slight. The other three substances employed to any extent are lubricating oil, fresh water and salt water. Lubricating oil has the distinct disadvantage that its specific heat is only about 0.4 of that of water, and hence about 2½ times as much must be circulated to carry off the same amount of heat within the same temperature limits. In addition, oil does not absorb heat from, or give heat to, a metallic surface as readily as does water. The one advantage of oil is that in case of any leakage inside of the crankcase it mixes with the other lubricating oil and does no damage.

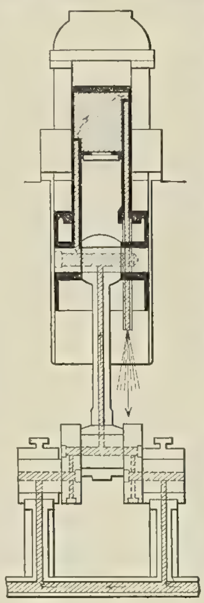
In view of all this, it is readily understood why lubricating oil is used only in special cases where certain conditions make the advantage more than outweigh the disadvantages. For instance, in a high-speed engine such as is used on a naval vessel the engine generally has trunk pistons and a closed crankcase. Here the cooling-oil system can be obtained with the lubricating-oil system and many parts eliminated. There are disadvantages in this, to be sure, but in the cramped quarters of a naval vessel they tend to disappear in the face of the advantages gained.

For commercial work it is safe to say that the choice lies between fresh and salt water. Fresh water requires an additional system, including tank, pump, cooler and piping, but it is not so corrosive, not so destructive to the packing in the joints of the system, not dangerous as regards deposits in the piston, and in case of leakage into the lubricating oil there is not the danger to bearings. When salt water is used with proper precautions, most of the advantages of fresh water disappear, but it is a question as to how far these precautions can be successfully carried out under every-day working conditions. Both fresh and salt water will undoubtedly be used for some time to come until enough experience is gained with both systems to finally settle the matter either one way or the other, or it may be that fresh water will be used for high-grade installations and salt water where first cost and simplicity are of prime importance.

Methods for Cooling the Piston

To carry the liquid to and from the piston there are three general systems, but the details for any one system are varied greatly by the various engine builders or by the same builder on different engines. One system is to combine the cooling with the lubrication system as in Fig. 4, but this, of course, is applicable only in case lubricating oil is used for cooling. The general scheme is to supply the oil to the main bearings, from whence it passes through the hollow crankshaft to the crankpin bearings and up the connecting rods to the wrist pins, thence through pipes or passages in the piston to the head and back again through a pipe or passage to some point near the bottom of the piston, from where it can drain directly into the crankpit. A certain amount of oil leaks out at the bearings and this serves to lubricate them.

A second system is to use jointed swinging pipes, and a third system telescopic pipes. Both inlet and outlet pipes can be and are generally used, so that any liquid desired can be employed for the cooling medium. The swinging pipes are suitable for slow-speed engines only, as at high speeds the inertia forces are very large and it is troublesome to take care of them properly. Moreover, the passage for the liquid must by the nature of the case have several bends and turns, and at high revolutions the inertia forces produce extremely high pressures, making it very difficult to keep the joints of the systems tight.



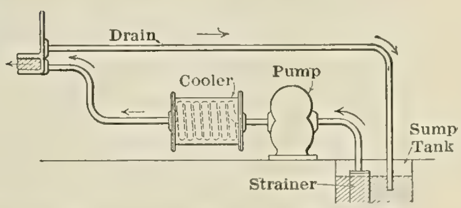


Fig. 4.—Combined Cooling and Lubricating Systems

There is one principle that must be followed in the design of swinging pipes for even moderate speeds, and that is to keep the bearings at the joints of the pipes entirely independent of the stuffing boxes, or in other words the piping for carrying the liquid and the strength members for taking the inertia forces must each do its own work, although they are fastened together and are a part of each other. The great trouble with this system is to keep it tight at the joints, and it is only by most careful

design along the lines stated that successful results can be obtained. In case water is used for a cooling medium, the lubrication of the bearings at the joints becomes important, but with forced lubrication there is generally enough oil flying around in the crankcase to take care of this, if pockets, connected to the bearings, are provided for catching it.

Telescopic pipes are adaptable to both high- and low-speed engines. All parts are moving in line with the cylinder axis and taking care of the inertia forces is much simpler than with the swinging links. Moreover, there are fewer turns in the passages for the cooling medium, and, as a general thing, air chambers can be placed so as to effectively care for the surges in the cooling liquids. An air chamber on the suction side is a necessity, but on the discharge side it may be dispensed with, provided the discharge pipes are of generous size. It is good practice to put an open-end pipe discharging into a funnel, with proper provision against splashing, on the discharge line, so that the cooling fluid coming from the piston can be actually seen by the operator. A certain amount of flexibility in the telescopic pipes is desirable in order to remedy any slight looseness of the piston, or of the crosshead in its guide, or any slight misalinement. One method of accomplishing this is to provide a double pipe—one pipe inside another. The inside pipe is fastened at one end to the piston or crosshead and at the other to the outside pipe. The outside pipe is guided in the part fixed to the engine frame. Here again the most troublesome part is the packing, but it is like packing the piston rod of an engine, and, as might be expected, the most satisfactory packing is of the labyrinth type, with provision for self-adjustment to the pipe, so that it fits snugly under all conditions.

Recent Developments in Shipyard Plants–II

Construction and Capacity of Fitting-Out Cranes—Special Facilities for Building and Installation of Gun Turrets—Shipyard Shops

BY NAVAL CONSTRUCTOR S. M. HENRY, U. S. N.

The nature of the building slips has been touched on, also the characteristics of the structural shop, and the next item which plays an important rôle in the general scheme of construction is the fitting-out crane, for on its size and ability to handle heavy weights is dependent to a considerable extent the point at which it is desirable to launch and the condition of assembly of machinery and other parts that can be taken care of.

Fitting-Out Crane

Compared with the large shipbuilding plants abroad, there is poor equipment for handling heavy weights in this country, whether in private yards or in government establishments. The maximum capacity of any crane in this country at the present time, so far as shipyards are concerned, is 150 tons, and there are few of these, whereas in the big foreign yards there are many cranes of 250 tons capacity. The great cost of this class of equipment has undoubtedly prevented its installation, especially in view of the fact that very large merchant construction has not been undertaken, and it has been possible to get through past naval programmes with available facilities. With the possibilities of larger merchant construction and the growth in the size of naval vessels and of their ordinance, 150-ton cranes are no longer of sufficient capacity, and provision for a materially larger lifting capacity must be made if future naval requirements are to be met.

The heaviest weights required in ship construction are the turrets of battleships. Their weight, stripped of armor and guns, is likely to be in excess of any practicable crane, so that the problem to be faced in determining crane capacity is how great a capacity can be obtained without involving excessive or unreasonable expenditures. All of the Navy's large cranes have so far been of the floating type, the earlier ones of the cantilever construction, and the later of the revolving, luffing type.

An investigation of the possibilities of building floating cranes of materially greater capacity led to the opinion that the cost of such cranes would become prohibitive, and, further, that their great size would be such as to make it practically as difficult to move them as to move the ship for which the weights are to be handled. This study further led to the view that it was feasible to obtain fixed shore cranes of the revolving, hammerhead type of 350 tons capacity, but that a capacity approaching this could not well be obtained with a traveling crane of any type, and that no other type appeared to compare favorably with the hammerhead type. As a result of this investigation, a crane is now under construction for one of our navy yards having a capacity of main hoist of 350 tons at a radius of 115 feet, and of 50 tons at a radius of 190 feet. In addition to the main hoist, there is an auxiliary hoist of 50 tons capacity. The height of the main hoist above the yard level is 145 feet. The base of the crane is of the portal type, the overall width being 61 feet, with a clear opening of 51 feet, allowing for a double track, standard gage system running through it.

It is proposed to install the crane on the center line of a pier of 100 feet width, giving a clear reach of 65 feet at 350 tons capacity, and 140 feet at 50 tons capacity. The crane will be installed 400 feet from the outer end of the pier 1,000 feet long, the location being based on allowing the handling of weights on any point of a vessel 1,000 feet long, and for giving the most convenient handling of weights for vessels of lesser lengths. So far as we know, this will be the largest crane that has yet been built for the shipbuilding industry. Located as outlined, the crane will give equal service on both sides of the pier, and can take the heaviest loads from barges on one side and place them on board vessels secured on the other side.

Turret Shop

One of the serious problems connected with the building of large naval vessels is the completion and installation of the turrets within the period of construction of the vessel. With comparatively limited weight handling facilities, the construction of the turret cannot proceed beyond the assembly of the bare structural work until after the vessel is launched, the heavy structure being handled in separate pieces to be assembled on board the vessel. The large amount of fitting and installing then remaining occupies the entire time until the vessel is completed. A

method of construction which offers much brighter prospects for rapidity, but involves large initial expenditures for equipment, is to build the turrets complete in a shop, to then remove the armor and guns and strip the turrets to a weight that can be handled by the fitting-out crane, and to lift the turrets on board in this condition soon after launching.

With a crane of the capacity described above, this process is entirely feasible, but involves the provision of a turret shop. The work to be done in such a shop is a combination of work such as is done in the structural shop and in the machine shop, and involves very heavy crane service and great height of building. In order to get the maximum benefit of the fitting-out crane, the capacities of the shop cranes should be equal to it, and designs have been prepared for a shop of this type which is to have a height to the under side of roof trusses of 94 feet and span of 100 feet, and to be fitted with two 150-ton bridge cranes, giving a combined capacity of 300 tons. With a shop of this character located on the waterfront, it will be feasible to extend the crane runway over the water a sufficient distance to permit the placing of a turret on a barge, which in turn will deliver it within reach of the fitting-out crane.

Owing to the great height of the completed turret structure, it is necessary either to provide a deep pit for the lower portion of the turret to extend into, or to provide an excessively high roof; or, what appears better, to combine the two methods, which can be done, with a height of 94 feet to the roof trusses and depth of pit of about 16 feet. These dimensions are sufficient to allow the complete assembly of a number of turrets and their removal from the shop as completed. A length of shop of about 60 feet per turret will be required.

Plant developments, such as are described above, are justified only where large construction work is to be carried out. In turn, such construction necessitates the production of large steel forgings and castings and their machining ready for installation. Few of the private yards have been in a position to make their largest iron castings, and practically none to make their steel castings and forgings. The present development of these shops in the navy yard is intended to place them in a position that will enable them to make promptly any repairs that may be needed in war time, with the single exception of heavy ordnance.

Forge Shop

In order to make the largest engine and hull forgings, an equipment consisting of a 2,000-ton high-speed steam hydraulic forging press and smaller presses and hammers is required, as well as furnaces and heat-treating equipment necessary in connection with the operation of presses of this size. A building consisting of a main bay 65 feet wide and 67 feet to the under side of roof trusses has been provided for the heavy forging work with two 80-ton cranes. In addition to the main bay, there is being provided a lower bay with 5-ton crane service, and with a height of 29 feet, to take care of the hand fires, etc. In view of the character of the work done in the boiler shop and the size of the crane equipment required for it, it has been considered desirable to combine these two shops in one, for this purpose providing a total length of 700 feet.

An effort has been made in laying out these shops to get away from the old idea that blacksmith or forge shop must necessarily be dirty and poorly lighted without the usual conveniences found in other shops. The type of construction is the same as adopted for the other large shops; that is, steel frame, hollow tile and steel sash sides and Aiken roof. It is intended to provide a wood block floor, except in certain locations of limited area where hot metal is likely to come in contact with it, in which locations cast plates will be fitted. With a clean floor, ample light and ventilation and oil fuel, it is expected that the working conditions can be made in this shop to approach those found in other yard shops.

Foundry

Provision will be made in the new foundries for the production of all sizes and characters of castings used aboard vessels. The buildings are to have a main bay 80 feet wide and 75 feet to roof trusses with about 80-ton and 15-ton cranes, as well as traveling wall cranes. The side bays are to be 55 and 45 feet wide, the one on the side opposite the cupolas to have a second floor. There will be provision for brass, iron and steel casting, the equipment including both electric and open hearth furnaces, able to make the largest steel castings called for by naval vessels.

Machine Shop

Provision in the machine shops must be made, not only for handling the forgings and castings of the largest size, for which some of the yards are already provided, but also to take care of a much larger volume of work than has been provided for in the past. The larger machine shops now under construction meet the general development under way in the other departments and consist of a main bay, 80 feet wide, with a height of 85 feet to the roof trusses; with a secondary bay, 50 feet wide, with a height of 26 feet to the cranes of 20 tons capacity; and a second floor of the same width, crane capacity of 5 tons, and a height of 18 feet to crane rail. Lean-tos outside of this take care of offices, tool rooms, locker rooms, etc. It is expected that a total length of shop of this section of approximately 1,000 feet will take care of all of the large work. In addition, a machine shop for small work will be provided of the same length with a width of approximately 60 feet and six stories in height.

The outline in the case of the last three shops is very brief and is intended only to give a general idea of the expansion and development found necessary and being made in these departments to conform to the developments under way in the departments that build the hulls.

The growth of many of the minor activities has not been out of proportion to that which we find in the main elements of the yards, and such activities as galvanizing and generation of oxygen, which have in the past been placed anywhere that room could be found for them, have grown to the dignity of independent shops of considerable size, and other activities are still coming on, which give promise of taking a prominent place in shipyard work, the most outstanding of these at the present time being electric welding.

We have to thank the present demand for ships for the progress that has been found possible in the development of the plants. With a continued demand for more and larger ships, it is to be expected that the growth of the plants, which has been begun, will be rounded out so that each department will in its own line be able to compare favorably with the best shops doing a similar character of work in other industries.

Institution of Naval Architects

The annual meeting of the Institution of Naval Architects will be held on April 9, 10 and 11, in the Royal Society of Arts, John street, Adelphi, London, W. C. The Right Honorable The Earl of Durham, K. G., G. C. V. O., P. C., president, will occupy the chair.

The annual dinner will be given on Wednesday, April 9, at 7:30 p. m., in the Grand Hall, Connaught Rooms, Great Queen street, Kingsway, W. C.

LIST OF VESSELS CONTRACTED FOR BY THE UNITED STATES SHIPPING BOARD EMERGENCY FLEET CORPORATION

WOODEN SHIPS CONTRACTED FOR

Ways for E.F.C.	Company	Design	D.W.T. per Ship	Contracted for and Pending: Total Ships	Contracted for and Pending: Total Tonnage
	North Atlantic District				
3	Continental S. B. Co.	Own	1,500	1	1,500
4	Cumberland S. B. Co.	Ferris	3,500	9	31,500
5	Foundation Co., The	“	3,500	10	35,000
3	Freeport S. B. Co.	“	3,500	4	14,000
1	Gilchrest, Geo. A.	“	3,500	1	3,500
2	Gildersleeve S. Constr. Co.	“	3,500	2	7,000
6	Groton Iron Works	“	3,500	12	42,000
6	Housatonic S. B. Co., Inc.	“	3,500	6	21,000
3	Johnson Shipyards Corp.	“	3,500	3	10,500
6	Kelley-Spear Co., The	“	3,500	1	3,500
3	Kingston S. B. Co.	“	3,500	7	24,500
3	Russell S. B. Co.	“	3,500	6	21,000
2	Sandy Point S. B. Corp.	“	3,500	2	7,000
12	Shattuck, L. H., Inc.	“	3,500	16	56,000
2	Ship Constr. & Trad. Co.	“	3,500	2	7,000
6	Traylor S. B. Corp.	“	3,500	10	35,000
	TOTAL			92	320,000
	Middle Atlantic District				
4	Maryland S. B. Co.	Ferris	3,500	6	21,000
4	Missouri B. & I. Co.	“	3,500	7	24,500
2	North Carolina S. B. Co.	“	3,500	4	14,000
4	Smith Henry & Sons Co.	“	3,500	4	14,000
3	Tenney, Chas. H.	“	3,500	4	14,000
4	York River S. B. Corp.	“	3,500	8	28,000
	TOTAL			33	115,500
	Southern District				
2	Alabama S. B. & D. D. Co.	Ferris	3,500	2	7,000
6	American S. B. Co.	“	3 500	10	35,000
4	Dantzler S. B. & D. D. Co.	“	3,500	6	21,000
4	Dierks Blodgett S. B. Co.	“	3,500	6	21,000
		Dough'y	5,000	6	30,000
7	Fahey, John H.	Ferris	3.500	8	28,000
4	Hodge Ship Co., Inc.	“	3,500	8	28,000
7	Jahncke S. B. Co., Inc.	“	3,500	12	42,000
4	Morey & Thomas	“	3,500	8	28,000
2	Murdock, J. H.	“	3,500	6	21,000
2	Murnan S. B. Corp.	“	3,500	4	14,000
2	National S. B. & D. D. Co.	“	3,500	2	7,000
4	Tampa Dock Co.	“	3,500	8	28,000
4	U. S. Maritime Corp.	“	3,500	9	31,500
	TOTAL			95	341,500
	Gulf District				
4	Beaumont S. B. & D. D. Co.	Ferris	3,500	12	42,000
4	Heldenfels Brothers	“	3,500	8	28,000
4	Lone Star S. B. Co.	“	3,500	8	28,000
2	McBride & Law	“	3,500	6	21,000
2	McCammon, J. M.	“	3,500	2	7,000
6	Midland Bridge Co.	“	3,500	8	28,000
7	National S. B. Co.	Dough'y	4,700	12	56,400
	“ “ “	“	5,000	16	80.000
5	Southern D. D. & S. B. Co.	Ferris	3,500	10	35,000
6	Union Bridge & Constr. Co.	“	3,500	6	21.000
	“ “ “	Dought'y	4,600	6	27,600
8	Universal S. B. Co.	Ferris	3,500	18	63,000
	TOTAL			112	437,000
	Southern Pacific District				
2	Benicia S. B. Corp.	Ferris	3,500	5	17,500
4	Chandler, Ralph J.	“	3,500	6	21,000
4	Coos Bay S. B. Co.	Hough	3,500	4	14.000
	“ “ “	Ferris	3,500	6	21,000
4	Fulton S. B. Co.	Hough	3,500	4	14.000
	“ “ “	Ferris	3,500	8	28,000
4	Hammond Lumber Co.	“	3,500	7	24,500
5	Kruse & Banks S. B. Co.	Hough	3,500	6	21.000
	“ “ “	Ferris	3,500	6	21.000
4	Rolph S. B. Co.	“	3,500	8	28,000
	TOTAL			60	210,000
	Northern Pacific District				
2	Allen S. B. Co.	Allen	3,650	3	10,950
2	Babare Bros.	Ferris	3,500	5	17,500
4	Grant Smith-Porter S. Co.	“	3,500	16	56,000
8	Grays Harbor M. S. Corp.	Gr. Harbor	4,000	17	68,000
	“ “ “ “	“ “	4,100	8	32 800
6	Meacham & Babcock S. B. Co.	Ferris	3,500	12	42,000
3	Nilson & Kelez S. B. Corp.	“	3,500	8	28,000
5	Pacific American Fisheries	Pac.Amer.	3,500	7	24,500
1	Patterson-McDonald S. B. Co.	Pat.-McD	4,800	4	19,200
6	Puget Sound Br. & D. Co.	Gr.Harbor	4,000	2	8,000
5	Sanderson & Porter	Ferris	3,500	15	52,500
4	Seaborn Shipyards Co.	“	3,500	14	49,000
14	Sloans Shipyard Corp.	“	3,500	16	56,000
6	Tacoma S. B. Co.	“	3,500	10	35,000
3	Wright Shipyards	“	3,500	9	31,500
	TOTAL			146	530,950
	District No. 11				
4	Coast S. B. Co.	Ferris	3,500	12	42,000
2	Feeney & Bremer Co.	“	3,500	2	7,000
8	Grant Smith-Porter Ship Co.	Hough	3,500	12	42,000
	“ “ “ “ “	Ferris	3,500	22	77,000
2	Kiernan & Kern	Ballin	4,500	4	18,000
6	McEachern Ship Co.	Hough	3,500	10	35,000
	“ “ “	Ferris	3,500	10	35,000
4	Peninsula S. B. Co.	Penin.	4,000	12	48,000
4	Rodgers & Co., Geo. F.	Ferris	3,500	8	28,000
4	Sommarstrom S. B. Co.	Hough	3,500	4	14,000
	“ “ “	Ferris	3,500	4	14,000
10	Standifer Constr. Corp. G. M.	“	3,500	14	49,000
	“ “ “ “	Ballin	4,500	12	54,000
3	St. Helens S. B. Co.	Ferris	3,500	6	21,000
4	Supple & Ballin	Ballin	4,500	4	18,000
4	Wilson S. B. Co.	Ferris	3,500	10	35,000
	TOTAL			146	537,000
	Great Lakes District				
	Lake & Ocean Nav. Co.	L. & O.	2,500	1	2,500
	GRAND TOTAL			685	2,494,450

WOOD TUGS CONTRACTED FOR

Ways for E.F.C.	Company	Design	Contracted for and Pending Number
	North Atlantic District		
6	Crowninshield S. B. Co.	Ocean	12
4	Cumberland S. B. Co.	Harbor	2
3	Continental S. B. Corp.	Ocean	2
4	Brown & Son, A. C.	Harbor	10
1	Gas Engine & Power Co. and Chas. L. Seabury & Co., Consol.	Harbor	6
2	International S. B. & Mar. E. Corp.	Harbor	5
2	Sullivan Co., J. W.	Harbor	4
	TOTAL		41
	Middle Atlantic District		
Bldg. 5	Chance Marine Constr. Co.	Harbor	6
3	Davis & Sons, M. M., Inc.	Ocean	20
2	Eastern Shore S. B. Corp.	Harbor	6
5	Mathis, John H. Co.	Harbor	5
3	Vinyard S. B. Co.	Harbor	3
	TOTAL		40
	Southern District		
1	Gibbs Gas Engine Co.	Harbor	6
2	Pilkington, George J.	Harbor	2
5	Southland S. S. Co.	Ocean	7
2	Ward & Pride	Harbor	2
	TOTAL		17
	Southern Pacific District		
Bldg.4	Main Iron Works (F. W. Stone)	Ocean	7
	TOTAL		7
	Great Lakes District		
5	Burger Boat Co.	Harbor	6
3	Dachel-Carter Boat Co.	Harbor	5
6	Leathem & Smith T. & W. Co.	Harbor	12
4	McLouth, Sidney C.	Ocean	9
8	Northwest Engr. Works	Ocean	1
	“ “ “	Harbor	16
3	Universal S. B. Co.	Ocean	3
	TOTAL		52
	GRAND TOTAL		157
		Ocean	61
		Harbor	96
	TOTAL		157

WOOD BARGES CONTRACTED FOR

Ways for E.F.C.	Company	D.W.T. per Ship	Contracted for and Pending: Total No. Ships	Contracted for and Pending: Total Tonnage
	North Atlantic			
2	Cobb S. B. Co., Francis	2,500	1	2,500
2	Crosby Navigation Co.	2,500	1	2,500
	“ “ “	3,500	1	3,500
1	Green Co., Richard T.	2,500	1	2,500
6	Kelley-Spear Co.	2,500	2	5,000
3	Machias Ship Constr. Co.	2,500	3	7,500
1	Newcastle S. B. Co., The	2,500	1	2,500
2	Sandy Point S. B. Corp.	2,500	2	5,000
3	Johnson Shipyards Corp.	2,500	2	5,000
	“ “ “	3,500	1	3,500
12	Shattuck, Inc., L. H.	3,500	2	7,000
	TOTAL		17	46,500
	Middle Atlantic			
5	Coastwise S. B. Co.	2,500	3	7,500
3	Crook Co., H. E.	2,500	2	5,000
2	Whitehaven S. B. Co.	2,500	2	5,000
	TOTAL		7	17,500

Ways For E.F.C.	Company	D. W. Tons Per Ships	Contracted for, and Pending: Total No. Ships	Total Tonnage
	Southern			
Bldg. 4	American Lumber Co.	2,500	2	5,000
7	St. Johns River Shipyard Company	2,500	3	7,500
	TOTAL		5	12,500
	Gulf			
4	Beaumont S. B. & D. D. Co.	2,000	2	4,000
6	Midland Bridge Co.	2,500	2	5,000
6	Union Bridge & Constr. Co.	2,500	3	7,500
	TOTAL		7	16,500
	Northern Pacific			
2	Allen S. B. Co.	3,650	1	3,650
6	Puget Sound Br. & Drdg. Co.	5,000	6	30,000
	TOTAL		7	33,650
	GRAND TOTAL		43	126,650

COMPOSITE SHIPS CONTRACTED FOR

	Company	Type	Design	D. W. T. Per Ship	Contracted for: No. Ships	Tonnage
	Southern					
4	Merrill-Stevens S. B. Corp.	Cargo	McClelland	3,500	8	28,000
6	Mobile S. B. Co., The	"	"	3,500	6	21,000
8	Terry S. B. Corp.	"	"	3,500	10	35,000
	TOTAL				24	84,000
	District No. 11					
4	Supple & Ballin	Cargo	Ballin	4,000	8	32,000
	GRAND TOTAL				32	116,000

STEEL SHIPS CONTRACTED, REQUISITIONED AND CONTRACTS.

Ways For E.F.C.	Company	Type	D. W. Tons Per Ship	Contracted for, Requisitioned and Contracts Pending: Total No. Ships	Total Tonnage
	North Atlantic District				
5	Atlantic Corp, The	Cargo	8,800	10	88,000
4	Bayles Shipyard, Inc	"	5,000	4	20,000
3	Bethlehem S. B. Corp., Ltd. (Fore River Plant)	"	8,500	2	17,000
	" " "	"	11,550	3	34,650
	" " "	"	14,000	2	28,000
	" " "	Tanker	9,100	8	72,800
4	(Moore Plant)	Cargo	3,500	2	7,000
	" "	Tanker	4,800	1	4,800
4	Downey S. B. Corp	Cargo	7,500	10	75,000
12	Federal S. B. Co	"	9,600	30	288,000
6	Groton Iron Works	"	8,800	6	52,800
	" " "	"	9,400	6	56,400
4	Newburgh Shipyards, Inc	"	9,000	12	108,000
8	Standard S. B. Co.	"	7,300	10	73,000
	" " "	Refrig.	7,300	3	21,900
	" " "	Cargo	7,433	10	74,330
2	Staten Island S. B. Co	"	3,500	5	17,500
28	Submarine Boat Corp	"	5,075	150	761,250
4	Texas S. S. Co.	"	9,530	2	19,060
	" " "	"	9,970	2	19,940
	" " "	Tanker	4,100	1	4,100
	" " "	"	9,500	4	38,000
	" " "	"	9,800	4	39,200
	TOTAL			287	1,920,730
	Middle Atlantic District				
6	Baltimore D. D. & S.B. Co.	Cargo	6,200	1	6,200
	" " " "	"	8,800	8	70,400
	" " " "	Tanker	5,000	1	5,000
	" " " "	"	6,000	6	36,000
	" " " "	"	10,300	12	123,600
	" " " "	Refrig.	6,200	9	55,800
7	Bethlehem S. B. Corp., Ltd. (Sparrows Point)	Cargo	5,500	1	5,500
	" " " "	"	7,400	9	66,600
	" " " "	"	7,500	2	15,000
	" " " "	"	10,100	2	20,200
	" " " "	Tanker	10,100	10	101,000
	" " " "	"	11,350	1	11,350
	" " " "	Trans.	13,000	8	104,000
4	Carolina S. B. Corp	Cargo	9,600	12	115,200
2	Newport News S. B. & D. D. Co	"	6,200	1	6,200
	" " " " " "	"	7,430	2	14,860
	" " " " " "	Tanker	7,200	2	14,400
	" " " " " "	"	11,375	10	113,750
	" " " " " "	"	14,800	1	14,800
	" " " " " "	"	14,900	1	14,900
	" " " " " "	Trans.	13,000	2	26,000
4	Virginia S. B. Corp	Cargo	9,400	12	112,800
	TOTAL			113	1,053,560

Ways For E.F.C.	Company	Type	D. W. Tons Per Ship	Contracted for, Requisitioned and Contracts Pending: No. Ships	Tonnage
	Delaware River District				
5	Bethlehem S. B. Corp., Ltd. (Harlan Plant)	Cargo	3,500	2	7,000
	" " " "	"	4,500	4	18,000
	" " " "	"	5,100	7	35,700
	" " " "	"	7,400	3	22,200
	" " " "	Tanker	7,500	6	45,000
	" " " "	"	8,130	3	24,390
	" " " "	"	11,720	1	11,720
6	Chester S. B. Co.	Cargo	7,500	1	7,500
	" " "	"	8,000	2	16,000
	" " "	"	8,725	7	61,075
	" " "	"	8,800	4	35,200
	" " "	"	9,000	14	126,000
	" " "	"	9,500	1	9,500
	" " "	Tanker	9,000	6	54,000
1	Cramp & Sons, Wm. S.&E.B.Co.	Cargo	9,400	2	18,800
	" " " " " "	"	9,500	2	19,000
	" " " " " "	Trans.	4,500	2	9,000
	" " " " " "	"	4,986	2	9,972
	" " " " " "	"	5,325	1	5,325
Bldg. 4	New York S. B. Corp.	Cargo	3,800	2	7,600
	" " " "	"	8,100	1	8,100
	" " " "	"	11,925	3	35,775
	" " " "	Tanker	7,300	1	7,300
	" " " "	"	8,620	1	8,620
	" " " "	"	12,300	1	12,300
	" " " "	"	12,650	2	25,300
	" " " "	Trans.	13,000	16	208,000
	" " " "	Collier	4,900	3	14,700
	" " " "	"	8,600	5	43,000
	" " " "	"	12,650	1	12,650
	" " " "	Trans.	5,325	2	10,650
4	Pusey & Jones	Cargo	4,000	6	24,000
	(Wilmington Plant)	"	4,350	8	34,800
6	(Penna. Plant)	"	7,500	2	15,000
	" "	"	12,500	11	137,500
	" "	Tanker	7,000	6	42,000
5	(New Jersey Plant)	Cargo	5,000	3	15,000
4	Sun S. B. Co.		10,000	12	120,000
	" " "	Tanker	10,000	2	20,000
	" " "	"	10,150	2	20,[illegible]00
	" " "	"	10,300	2	20,600
	" " "	"	10,600	8	84,800
	TOTAL			170	1,463,377
	Delaware River Agencies				
50	American Inter. S. B. Corp.	Cargo	7,500	110	825,000
	" " " "	Trans.	8,000	70	560,000
12	Merchant S. B. Corp	Cargo	9,000	60	540,000
	TOTAL			240	1,925,000
	Southern District				
4	Daniels Co., Oscar	Cargo	9,500	10	95,000
Bldg. 4	Doullut & Williams S. B. Co.	"	9,600	8	76,800
4	Merrill-Stevens S. B. Corp.	"	4,300	5	21,500
	" " " "	"	6,000	5	30,000
	" " " "	"	9,000	6	54,000
6	Mobile S. B. Co., The	"	5,000	24	120,000
5	Pensacola S. B. Co.	"	9,000	16	144,000
See Daniel	Tampa S. B. & Engr. Co.	"	3,500	2	7,000
8	Terry S. B. Corp.	Tanker	7,500	10	75,000
	TOTAL			86	623,300
	Southern Pacific District				
6	Bethlehem S. B. Corp. Ltd.	Cargo	6,000	1	6,000
	" " " " "	"	11,700	1	11,700
	" " " " "	"	11,800	18	212,400
	" " " " "	"	12,000	1	12,000
	" " " " "	Tanker	10 100	18	181,800
	" " " " "	"	10,475	8	83,800
	" " " " "	"	14,900	2	29,800
3	Hanlon D. D. & S. B. Co.	Cargo	5,350	12	64,200
	" " " " "	"	5,500	2	11,000
4	Long Beach S. B. Co.	"	3,000	2	6,000
	" " " "	"	6,000	3	18,000
	" " " "	"	8,800	12	105,600
	" " " "	Schooner	3,200	1	3,200
6	Los Angeles S. B. & D. D. Co.	Cargo	8,800	40	352,000
7	Moore S. B. Co.	"	7,100	1	7,100
	" " "	"	9,400	32	300,800
	" " "	Tanker	10,000	12	120,000
	" " "	Refrig.	9,400	4	37,600
4	Pacific Coast S. B. Co.	Cargo	9,400	10	94,000
4	Southwestern S. B. Co.	"	8,800	23	202,400
3	Union Industrial Works	"	9,400	10	94,000
4	Western Pipe & Steel Co. of Cal.	"	8,800	22	193,600
	TOTAL			235	2,147,000
	Northern Pacific District				
5	Albina Eng. & Mach. Wks., Inc.	Cargo	3,300	2	6,600
	" " " " " "	"	3,700	13	48,100
	" " " " " "	"	3,800	4	15,200
4	Ames S. B. & D. D. Co.	Trans.	8,500	3	25,500
	" " " " "	Cargo	8,800	22	193,600

Ways for E.F.C.	Company	Type	D. W. Tons Per Ship	Contracted for, Requisitioned and Contracts Pending — Total No. Ships	Total Tonnage
	Northern Pacific District (Cont.)				
	Ames S. B. & D. D. Co.	Tanker	9,000	2	18,000
5	Columbia River S. B. Corp.	Cargo	8,800	32	281,600
4	Duthie & Co., J. F.	"	8,800	27	237,600
4	Northwest Steel Co.	"	8,800	41	360,800
5	Seattle Constr. & D. D. Co.	"	7,500	21	157,500
	" " " "	"	10,500	1	10,500
5	Seattle Nor. Pac. S. B. Co.	"	9,400	10	94,000
5	Skinner & Eddy Corp.	"	8,694	1	8,694
	" " "	"	8,800	30	264,000
	" " "	"	9,600	58	556,800
	" " "	Tanker	9,000	1	9,000
5	Standifer, G. M. Constr. Corp.	Cargo	9,500	15	142,500
7	Todd D. D. & Constr. Corp.	"	7,500	24	180,000
	TOTAL			307	2,609,994
	Great Lakes District				
	American S. B. Co., The	Cargo	3,550	5	17,750
3	(Buffalo Plant)	"	4,200	3	12,600
	" "	"	4,050	3	12,150
6	(Chicago Plant)	"	3,100	4	12,400
	" "	"	3,550	9	31,950
	" "	"	4,050	7	28,350
	" "	"	4,200	7	29,400
3	(Cleveland Plant)	"	3,100	4	12,400
	" "	"	3,550	10	35,500
	" "	"	4,050	6	24,300
	" "	"	4,200	6	25,200
10	(Detroit Plant)	"	3,100	10	31,000
	" "	"	3,550	15	53,250
	" "	"	4,050	24	97,200
	" "	"	4,100	2	8,200
	" "	"	4,200	20	84,000
8	(Lorain Plant)	"	3,100	9	27,900
	" "	"	3,550	11	39,050
	" "	"	4,050	14	56,700
	" "	"	4,200	18	75,600
5	(Superior Plant)	"	3,100	4	12,400
	" "	"	3,550	6	21,300
	" "	"	4,050	6	24,300
	" "	"	4,200	6	25,200
5	Globe S. B. Co.	"	3,500	10	35,000
	" " "	"	4,050	10	40,500
	Great Lakes Engr. Works	"	3,300	15	49,500
8	(Ecorse Plant)	"	3,350	4	13,400
	" "	"	3,400	1	3,400
	" "	"	4,000	2	8,000
	" "	"	4,050	16	64,800
	" "	"	4,200	17	71,400
	" "	"	5,500	2	11,000
3	(Ashtabula Plant)	"	3,300	8	26,400
	" "	"	3,350	2	6,700
	" "	"	4,000	2	8,000
	" "	"	4,050	8	32,400
	" "	"	4,200	7	29,400
6	Manitowoc S. B. Co.	"	3,400	14	47,600
	" " "	"	3,500	8	28,000
	" " "	"	4,050	18	72,900
9	McDougall-Duluth Co.	"	3,100	7	21,700
	" " "	"	3,300	2	6,600
	" " "	"	3,500	10	35,000
	" " "	"	4,050	15	60,750
4	Saginaw S. B. Co.	"	3,500	12	42,000
	" " "	"	4,050	12	48,600
6	Toledo S. B. Co.	"	2,930	10	29,300
	" " "	"	3,500	8	28,000
	" " "	"	4,050	16	64,800
	TOTAL			445	1,683,250
	Japan Contracts				
	Asahi	Cargo	5,500	1	5,500
	Fujinigata	"	6,300	1	6,300
	Harima Co.	"	5,000	1	5,000
	" "	"	10,500	1	10,500
	Ishikawajima	"	5,000	2	10,000
	Kawasaki	"	9,000	5	45,000
	Nitta	"	5,500	1	5,500
	Yokohoma	"	6,300	3	18,900
	Asano	"	12,600	2	25,200
	Japan Contracts				
	Uraga	Cargo	6,650	3	19,950
	Mittsue Bussan	"	9,100	2	18,200
	Mitsubishi	"	8,400	2	16,800
	Uchiba	"	8,500	2	17,000
	Osaka	"	10,500	4	42,000
	TOTAL			30	245,850
	Japan Purchased				
	Kawasaki	Cargo	9,000	2	18,000
	"	"	9,103	1	9,103
	"	"	9,027	1	9,027
	"	"	9,066	1	9,066
	"	"	9,062	1	9,062
	"	"	9,070	1	9,070
	Uraga	"	6,771	1	6,771
	Suzuki	"	5,000	1	5,000
	"	"	6,775	1	6,775
	Asaha	"	10,705	1	10,705
	Suzuki	"	11,033	1	11,033
	Nippen Kissen Kiashi	"	6,695	1	6,695
	Kuhara	"	6,699	1	6,699
	Asano	"	11,600	1	11,600
	TOTAL			15	128,606
	China				
	Kiangnan Dock & Eng. Wks.	Cargo	10,000	4	40,000

Ways For E.F.C.	Company	Type	D. W. Tons Per Ship	Contracted for, Requisition and Contracts Pending — Total No. Ships	Total Tonnage
	Recapitulation				
	North Atlantic			287	1,920,730
	Middle Atlantic			113	1,053,560
	Delaware River			170	1,463,377
	Delaware River Agencies			240	1,925,000
	Southern			86	623,300
	Southern Pacific			235	2,147,000
	Northern Pacific			307	2,609,994
	Great Lakes			445	1,683,250
	ENTIRE COUNTRY			1,883	13,426,211
	Japan			45	374,456
	China			4	40,000
	GRAND TOTAL			1,932	13,840,667
	Resume of All Steel Ships				
	Under 5,000 D. W. Tons			510	1,938,322
	5,000 to 5,999 D. W. Tons			215	1,095,625
	6,000 to 7,499 D. W. Tons			84	573,980
	7,500 to 8,500 D. W. Tons			271	2,079,790
	8,501 to 9,999 D. W. Tons			664	6,038,717
	10,000 and over D. W. Tons			188	2,114,233
	TOTAL			1,932	13,840,667
	Tugs No. D. W. Tons			112	A
	Barges 2,000 D. W. Tons			8	16,000
	7,500 D. W. Tons			2	15,000
	TOTAL			122	31,000
	GRAND TOTAL			2,054	13,871,667

STEEL TUGS CONTRACTED FOR AND CONTRACTS PENDING

Ways For E.F.C.	Company	Type	D. W. Tons Per Ship	Total No. Ships	Total Tonnage
	North Atlantic District				
4	Bayles Shipyard, Inc.	Ocean	A	8	A
4	Bethlehem S. B. Corp., Ltd.	"	A	30	A
Bldg. 4	Gahagan, W. H., Inc.	"	A	10	A
1	Gas Engine & Power Co., (Chas. L. Seabury Consld)	"	A	3	A
4	Newburgh Shipyards, Inc.	"	A	3	A
2	New Jersey D. D. & Trans. Co.	"	A	2	A
5	Providence Engr. Corp.	"	A	10	A
	TOTAL			66	A
	Southern District				
Bldg. 4	Johnson Iron Works, Ltd.	Harbor	A	6	A
	Great Lakes District				
Bldg. 3	Foundation Co., The	Ocean	A	10	A
2	Lake & Ocean S. B. Co.	"	A	3	A
8	Northwest Engr. Works	"	A	15	A
	" " "	Harbor	A	2	A
4	Whitney Bros. Co.	Ocean	A	10	A
	TOTAL			40	A
	ENTIRE COUNTRY	Ocean	A	104	A
		Harbor	A	8	A
	GRAND TOTAL			112	A

STEEL BARGES CONTRACTED FOR AND CONTRACTS PENDING

Ways For E.F.C.	Company	Type	D. W. Tons Per Ship	Total No. Ships	Total Tonnage
	Southern District				
1	Alabama D. D. & S. B. Co.	Canal	7,500	2	15,000
Bldg. 2	Nashville Bridge Co.	Oil	2,000	8	16,000
	TOTAL			10	31,000

CONCRETE SHIPS CONTRACTED FOR

Ways For E.F.C.	Company	Type	D. W. Tons Per Ship	Total No. Ships	Total Tonnage
	North Atlantic District				
1	Fougner Amer. S. Con. S.B. Co.	Cargo	3,500	1	3,500
	Middle Atlantic District				
Bldg. 2	Liberty S. B. Co.	Cargo	3,500	2	7,000
	" " "	Tanker	7,500	2	15,000
	TOTAL			4	22,000
	Southern District				
Bldg. 2	Bentley & Sons Co., The A.	Tanker	7,500	4	30,000
1	Liberty S. B. Co.	Cargo	3,000	1	3,000
1	Ley & Co., Inc., Fred T.	Tanker	7,500	4	30,000
	TOTAL			9	63,000
	Southern Pacific District				
3	San Francisco S. B. Co.	Tanker	7,500	4	30,000
1	Pacific Mar. & Constr. Co.	"	7,500	4	30,000
	TOTAL			8	60,000
	GRAND TOTAL			22	148,500

Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliares—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

A Piston Repair

While on watch one day after going the rounds of the engine room to see that all was right, I was greatly surprised to hear a knock on one of the donkey pumps. The pump was immediately stopped and a thorough inspection made. I could find nothing wrong with the external gear, so the cylinder cover was removed, when it was seen that a piece of the piston was broken off, the fracture extending across the top of the piston about 4 inches and down the body of the piston to about 1¼ inches below the groove for the piston ring. It was a lucky thing for us that the fractured part happened to be on the side opposite the steam port, for there is no saying what might have happened if it had been on the same side.

As we had about a week's voyage before we reached our home port, it was deemed advisable to make the repairs as soon as possible, since it is a well-known fact that donkey pumps sometimes move only when it suits themselves.

The fracture of the piston was repaired in the following manner: Two 11/16-inch holes were drilled on the top side of the broken piece and three 11/16-inch holes on the body part. The broken piece was then replaced and the holes marked off on the piston proper. These holes were then drilled for ⅝-inch taps, after which studs were screwed in and the fractured piece riveted on, the holes in the broken piece having previously been countersunk so as to make a good tight job.

The piston was put in the lathe and its diameter reduced from 7 inches to 6⅝ inches, thus eradicating the grooves for the piston rings. A piece of plate ⅝-inch thick was then procured and cut to the depth of the piston. The two ends of the plate were scarfed down by means of a hammer and chisel and finished off with a file. The plate was then placed in the furnace fire and heated up to a welding heat, the scarfed ends being hammered together to make a good joint. This operation required three heats to make a good job, owing to the lack of sufficient tools to do the work (the usual thing at sea). However, we were glad to feel that we had been successful.

The plate was finally subjected to another heat—this time just red—and while at this temperature it was carefully shrunk onto the piston and allowed to cool. When the plate was sufficiently cool we proceeded to drill a number of ⅝-inch tapping holes right through the liner and into the body of the piston for a depth of ¾ inch. The holes were then tapped and the studs screwed in, the holes in the liner being previously countersunk for riveting. In marking off the holes, great care was taken that they should not fall where the piston ring grooves were to be cut or where the holes would come in contact with the fractured part.

After all the riveting was finished the plate was put into the lathe and reduced to its working size (7 inches). The grooves were then cut and new rings fitted. To make sure that no steam would pass up or down between the liner and the piston, both ends were calked. Finally the piston rod was put in place, the nut screwed up and then the piston was put into the cylinder and coupled onto the connecting rod.

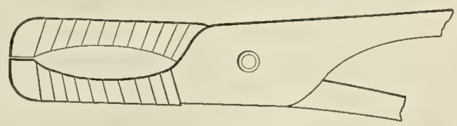
When the pump was started, to everyone's joy the job proved most satisfactory; in fact we never had any more trouble with it.

Sydney, N. S. W. A. LANG.

Tool for Handling Grease Cups and Other Polished Piping

Considerable time is frequently wasted in removing and replacing brass grease cups because of the care taken to prevent the scratching or scarring of the soft, polished brass parts with the ordinary steel jaw pliers or wrenches. To avoid this the writer hit on the scheme of making up a set of special pliers to handle this brass work.

The jaws of a pair of Utica gas pliers were ground out



Special Pliers for Handling Brass Work

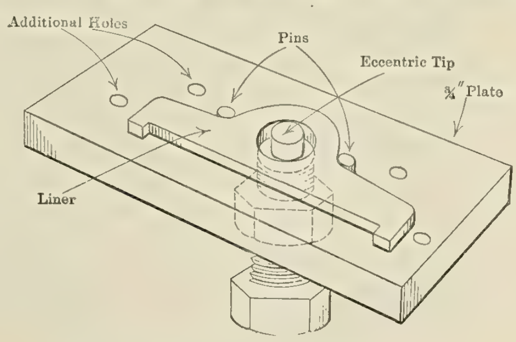
smooth to the shape shown in the sketch and then covered with a thick wrapping of electric tape. When this tape wrapping hardened it offered an excellent grip on the brass without scarring or cutting it.

This little scheme worked out so satisfactorily that several other similar pliers were made up, including a tape-protected wrench, for handling highly polished oil and other brass piping.

Philadelphia, Pa. W. A. LAILER.

Liner Filing Vise

On board ship there are a large number of small bearings that require frequent adjustment, and all of these bearings are fitted with liners or shims, and sometimes it is necessary to thin down some of the thick liners. The



Vise for Holding Liners When Filing

vise shown in the sketch is a very useful affair for gripping such liners when filing them down.

It consists of a piece of ¾-inch plate with a hole drilled and tapped to receive the bolt shown at *A*. The tip of this bolt is turned eccentric, and this tip, when the bolt is

turned, will force the liner against the two pins indicated, thus clamping it. Additional holes permit the pins to be shifted to suit other style liners.

Machinist.

Two Note Book Kinks

Clip these two sketches out and paste them in your note book; then sometime when you come across an old carpenter's ratchet brace convert it into a handy small ratchet drill by cutting off the handle at the place shown in the

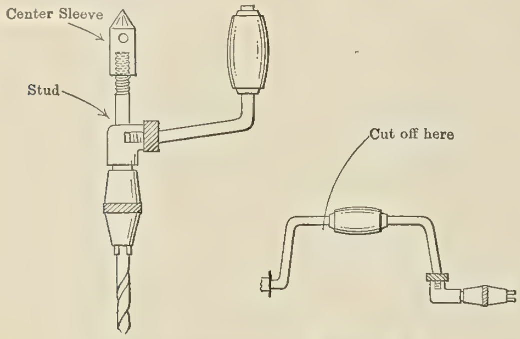


Fig. 1.—Improvised Rachet Drill

small view and then putting a small 3/8-inch stud in the back end of the chuck or brace head as indicated. Make a center sleeve for feeding the ratchet, and the tool is ready for use.

Most all sea-going men to-day use safety razors, therefore there must be lots of discarded safety razor blades

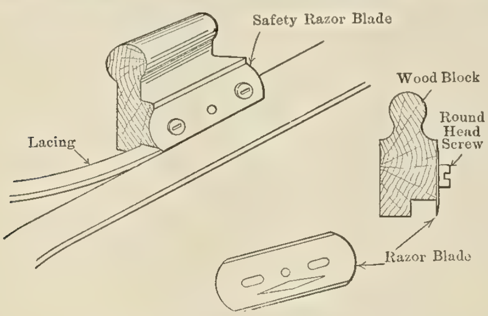


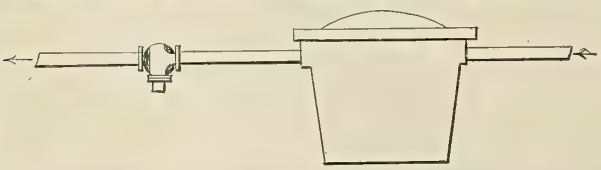
Fig. 2.—Belt Lace Cutter

about the washroom shelves. Pick them up and save them; there are many good uses for them. One is shown in the sketch Fig. 2—a belt lace cutter. This sketch needs no description, other than saying that the blade is secured through the holes in it by small round-head screws.

Assistant.

Tell-Tale on Steam Trap

Where a number of traps are discharging into a returns or sump tank it is very difficult to be able to detect when



Three-Way Valve Used as Tell-Tale on Steam Trap

the traps are leaky or which particular traps require attention. In order to provide a check or tell-tale for each trap, we secured some three-way valves and installed them on the outlet of each of our traps. Ordinarily the three-way valve was placed so that the trap discharge blew through to the receiving tank as ordinarily, the by-pass pipe being shut off by the blanked side of the valve. However, when we desired to check how the trap was working, or whether it was leaking, the three-way valve was turned to divert the steam through a bypass connection to the atmosphere. When thus by-passed, we could observe the action of the trap, determine the quantity of water it discharged, whether it shut off promptly or whether it constantly leaked steam, etc.

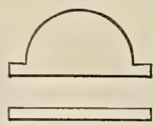
W. A. L.

Sounding Rod for Double Bottoms

The type of sounding rod or stick used on board most steamships for sounding the depth of water in bilges and double bottom compartments is nothing more than a rod of steel graduated in inches over which is rubbed a little chalk. Dropping this into the sounding tube, the water wets the rod thus marking on the chalk the indicated depth. This rod is fairly satisfactory, but it has some faults, among which are the following:

When the rod is put into the tube it sometimes gets wet from moisture in the tube, or the chalk gets rubbed off in dropping the rod down through a long tube such as one of the sounding tubes from the upper decks to the bilges. Sometimes there is not a piece of chalk to be found.

To avoid these troubles and to get an accurate sounding of the double bottom, I have adopted a sounding rod such as shown in Fig. 1. It is a homemade affair made out of a piece of half-inch brass pipe split in half lengthwise. At intervals of one inch a small slot is cut the width of a hacksaw blade; into these slots small steps, made as shown in Fig. 2, are placed and soldered. The slots are cut at an angle of about 45 degrees and just deep enough to take the shoulder of the brass step. Small pockets are formed in the completed rod. When the rod is dropped into the tube for a sounding, the water or liquid is accurately measured by the filled pockets.



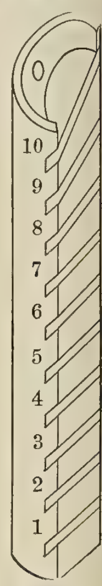


Fig. 2 Fig. 1

Improvised Sounding Rod

To make this type of rod requires patience, but the oiler or the water-tender who has to sound the reserve feed every watch will surely appreciate having one.

Oiler.

Cleaning Water Sides of Babcock & Wilcox Boilers

Since a great many ships are equipped with Babcock & Wilcox boilers, no doubt the methods used to clean the water sides of these boilers would be of some interest to all engineers, for we all have ideas of our own which we get by experience.

In the plant under my care there are sixteen Babcock & Wilcox watertube single-drum boilers of the 27 header type with cross boxes at the front. We cannot lay down a definite cleaning schedule, due to the various demands made upon the plant for different speeds and sailing orders. However, we try to clean each boiler as regularly

as possible and within a radius of 1,200 steaming hours. If the make-up of the feed water used is clean or free from solids, this period is just about right; but when water is used, unavoidably, that contains fouling matter, or salt feed, oil, grease, etc., the boilers should be examined oftener for safety. To do this it is only necessary to open a few scattered handhole plates and one manhole plate. Often this reveals a condition that is not expected. Many times this small inspection has enabled us to keep the boiler in service longer than 1,200 hours. When a general inspection, as referred to above, is made you can determine the kind of deposit that is present. If it is soft and not of a scale-forming nature, a good washing out under 75 to 100 pounds pressure will take most of this off and the boilers are in condition to steam longer.

When a condition such as above is found, we send two men into the steam drum with a fire hose. The hose has a nozzle opening of 2 inches, with handles, so that it can be held in the tubes. When the pressure is going through it, we take off the bottom front row of handhole plates, so that the water has plenty of outlet. The hose with pressure is put in the end of each circulating tube in the steam drum and kept there for at least four or five minutes; then each header is washed down through the nipples. The hose is then put into the bottom of each 4-inch tube at the front end where the plate is off; they have previously been cleaned by running a brush through them once. This row of tubes is directly over the fire, and, since the tubes are large, it is necessary to take the plate off these to aid the washing out process. We always clean these tubes thoroughly. After washing, all plates are carefully replaced and the boilers are ready. The whole operation of opening these few plates, washing and closing the tubes, can be accomplished in a few hours, the actual time being six hours for four boilers, the work on each progressing in conjunction with the others. These inspections save time, labor, boiler gaskets, etc., and also give more boiler service with a feeling of safety. No boiler that is known to have deposits or fouling on the heating surface of its water sides is in a safe condition for steaming. This is often the cause of overheating.

When the boilers are to be thoroughly cleaned, they are taken out of the line, and when the stop valves are secured we introduce 25 pounds of boiler compound in solution into the steam drum. While the fires are dying the water is circulated by an auxiliary feed pump taking a suction from the bottom blow-down valve and feeding it back into the steam space. This does very good work, and it will be found that when you open the boiler the sediment dries very readily and is easy to remove. When the fires are dead and the boiler water cooled to about 175 degrees, the bottom front upright or leg plates are kicked in with a long bar, and the water and scum emptied into the bilge. All front header plates are rapidly taken off, also leg and crossbox plates, and the lower row of plates in the back headers.

We generally work the cleaning of at least four boilers together; and as the saving of time in cleaning or laying up of a boiler is always urgent in this plant, we plan to have all cleaning tools, such as brushes, scrapers and air tools, in condition to expedite the work. As soon as the first plate is taken off, the actual work of cleaning is begun —320 hand-hole plates to each boiler are cleaned, the threads of the studs oiled, the nuts made to go on easy, etc. This is all done by four men in three days of eight hours, or in three watches (we always work the cleaning in watches).

If the sediment on the inside of the tubes is dry, the punching of them with spiral wire tube brushes is immediately begun. There are 902 two-inch tubes and 57 four-inch tubes to a boiler. The cleaning brushes are passed through each one twice. Working two brushes to a boiler, it takes twenty hours. One man is in each steam drum punching the circulating tubes, down-take nipples and scraping the shell. As fast as the tubes of one header are cleaned a man follows with brushes and scrapers, cleaning the seats for the new gaskets. During the progress of cleaning, the boiler is inspected by the engineer for structural defects, the firesides are cleaned and the fire tiles examined—in fact, the whole boiler setting is given attention. When the dirt or sediment shows a tendency to be troublesome in removing, we use brushes on a rod in a reversible air motor—just the common spiral wire tube brush, secured in a piece of rod. This wears the brushes out much sooner than hand punching; but even when worn they do good work, for they will always run out of true, so that they touch all around the tube. At the completion of the cleaning with brushes, the loose dirt is blown out with air, the whole boiler washed out with a 60-pound pressure of water, and immediately closed and filled with hot water to prevent rusting. This softens the gaskets and they can be set up tighter. The average length of time required to complete this method of cleaning is thirty-six hours for four boilers.

Concord, N. H. C. H. Willey.

Waste Heat Utilization

The method of obtaining fresh water for marine purposes, proposed by Mr. Cole Newman in the December issue, is a rather remarkable proposition. The writer seems blessed with a vivid imagination untempered by any practical considerations whatsoever. If the article is serious, the mind of the writer is apart from rational perspective; to the marine engineer conversant with the problems involved, the idea of obtaining water from smoke is as visionary as the proposed raw material.

Production of CO_2 from the products of combustion in a boiler is a well-known process practiced for the purpose of obtaining a refrigerant media. The plant involved is, however, very considerable, and on a ship would occupy more space than the existing total power equipment. The writer has been privileged with unrestricted access to one of the largest plants in England making CO_2 as a commercial venture. The plant for the recovery of the moisture in the combustion products of boilers would occupy at least equal space.

Like others who have mentioned sea water distillation in these pages, reference is made in the article to the problem of salt incrustation in distilling apparatus using sea water. Such a belief is based on misconception and is at variance with fact. The present writer, from practical experience with evaporative plants at sea and extended tests of land installations, is in a position to state that the deposit of incrustation met with due to such evaporation is the limy deposit known as boiler scale; *salt, as such, does not deposit unless the plant is mismanaged.*

Salt water feed in Scotch boilers does not lead to the deposition of salt, provided always that the man responsible knows the elementary facts concerning the use of salinometer and fractional blow-down. Distillation compares equally and exactly and is subject to the same practice, the rule being never to exceed 3/32 density. What actually happens is concentration of the original sea water into denser brine. Total evaporation would, of course, crystallize out the salt, but until the saturation point is reached there is no tendency to do this. The matter can

be proved by a simple experiment by either making up a solution from known ingredients or evaporating away given amounts of sea water.

The usual practical assumption is that under boiler conditions actual salt does not deposit until a density of 7/32 is reached. Incrustation is heavy, of the usual lime magnesia type, since the whole of this contained in the water is precipitated.

This point is dealt with because in recent conversations with competent engineers unacquainted with the special problems involved in distillation of sea water on a large scale, they all assumed that deposition of salt was the main drawback. The present writer, in common with thousands of others, has had practical experience in the use of salt makeup feed with Scotch boilers and triple-expansion engines, the addition of small quantities subject to limits of total density being operative for months on end. Total salt water feed was at one time usual when boiler pressures were lower, but, although incrustation is heavy in a case of this kind, salt does not deposit. An external leak will show ropes of salt due to total evaporation, but this external boiling-off is not indicative of similar conditions internally.

Salt water distillation is comparable in all respects with total salt water boiler feed; the density is held below 3/32 by the salinometer test, a fractional proportion of the contents of the evaporator being continuously run to waste through blow-down. Those unacquainted with this matter of continuous fractional blow-down in marine boilers are advised to consult any good marine text book which treats the matter fully.

Returning to the proposals ventilated by Mr. Newman, potable water made in a modern distillation plant from sea water is unusually pure even under the most delicate nitrate of silver test. The process is simple, direct and well known, the plant occupies small space, and in competent hands involves very little trouble. A quadruple effect plant has, under the writer's supervision, given 33 pounds of fresh water produced for one pound of Welsh coal burned; this was a new plant under very exacting test conditions. Moreover, the moisture, which forms a very insignificant portion of the products of combustion, involves the treatment of the whole of these through apparatus of very large size, the resultant, when and if obtained, would be so foul and so impure that rectification would still involve distillation. Sea water is at least clean when heated, it does not give off tainted odors to contaminate the distillate, and to recover at infinite cost an inferior raw material with the whole ocean overside is simple folly. In spite, therefore, of spoiling the boiler draft, impairing combustion of the original fuel, making larger boiler power essential and the provision of a large after treatment plant necessary, the resultant would be an unpleasant fluid needing still the usual process to rectify. "Looping the loop" in this wise is pure absurdity.

In the case of an internal combustion engine, freedom of exhaust is very necessary, and to impair this to recover the moisture present is equally uneconomic and absurd.

The present writer has two recollections of interest to relate. The first concerns a case where he was called into consultation relative to using the exhaust heat from a number of large gas engines. It was required to heat a definite amount of water a given temperature, and the joke was that to do this would require more than half the thermal value of the total gas used as fuel in the engines. Someone, struck by the fact that the exhaust products were obviously hot, thought that there was a great waste of heat and proposed to install a heater to use it up.

The amount of unexpended heat in an internal combustion engine is by no means great. The original thermal content of the fuel has had the major portion already utilized as power. The more economical the engine, the less the inevitable wastage.

The second case concerns an experimental test to use the same source of heat through the combustion chamber of a locomotive boiler, in this instance with the intention of subsequent distillation. A rather bad exhaust backfire shifted the boiler bodily and the experiments were abandoned.

At the same time the exhaust heat of a large oil-propelling set might conceivably by special arrangement serve the purpose of fresh water supply. Provided that the engines were of considerable size and the distilling requirements small, the problem might meet satisfactory solution.

Preheating the fuel oil by means of the exhaust pipe heat is common enough; it gives fluidity to very viscous fuels. In the same manner the preheated jacket water used as feed, surrounding the exhaust pipe by suitable means, might evaporate small quantities of steam for subsequent condensation. This would allow free exhaust to the engines and give a source of heat available and hitherto wasted. Fractional blow-down would have to be practiced, if the water be salt.

There is a certain feasibility in the project so outlined, and expectations as to the quantity of distillate must be extremely conservative. Assuming that 10 percent of the total thermal value of the original fuel escapes to the atmosphere and that one-third of this can be recovered, taking a consumption of .5 pound per horsepower hour and a value of 20,000 B.t.u. per pound, 300 pounds of water evaporated per hour from 1,000 horsepower is the result. It would be safe to assume a further one-third loss of, say, 20 gallons per hour as a likely result. In continuous operation this means 480 gallons per day. The temperature of the exhaust is assumed to be sufficiently high to evaporate water into steam, and the entire figuring is based upon unproven assumptions.

In this connection, feed heaters based upon funnel temperature and dependent upon using the waste heat of the products of combustion from boilers are commonplace in land power plants. Due probably to constructional difficulties they have never met with much favor in marine connections, so that utilization of internal combustion engine exhaust heat may not be practical politics upon trial.

The subject of utilizing waste heat by apparatus designed to that end is very interesting; the best use that has yet been made in the case of steam plants is to heat feed water. Still in a condensing engine it is questionable whether utilizing the exhaust steam and impairing the vacuum is worth while; anything interposed, which hampers free exhaust, minimizes power.

So weird a project as that of Mr. Newman is certainly impracticable. It is the fruit of vivid imagination wedded to practical inexperience without logical reflection as to the problems involved.

London. A. L. Haas.

Firemen Wanted on Merchant Ships

The United States Shipping Board wants 1,500 husky young Americans at once to learn the business of firing boilers on the new ships of the merchant marine. The men accepted will be placed on training ships at $30 a month training pay for thirty days, and will then be sent on deep-water voyages at $75 a month. Uniform and board are furnished. Discharged soldiers and naval reservists are eligible for this work. Other young men of good physique and habits, weighing 140 pounds or more, will also be accepted.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

CONDUCTED BY "NAVAL ARCHITECT"

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

There will appear in this column from time to time questions which have been asked by the Board of Steamboat Inspectors in the various examinations for engineers' licenses conducted by them. Such questions will be denoted by an asterisk (*) placed before the number if from examination for grade of chief, and by a dagger (†) if from examination for other grades.

Water Level in Gage Glass and in Boiler

Q. (996).—Does the water column on a boiler show the true water level? How much higher is the water in the boiler than in the glass?

A. (996).—The gage glass does not show the true level of water in the boiler. This is due to several causes. The chief one is that the density of the water is not the same in the boiler as in the glass, due to difference in temperature and freshness. Again, if the upper branch of the water column is near a steam outlet, this will be sure to affect the water level. Water in the gage glass will be cooler than that in the boiler, which makes the former denser, or the difference in temperature will cause the level to be lower in the gage glass than in the boiler. The amount of this difference in level will depend upon the length of gage glass.

Piston Ring Design

Q. (997).—Will you kindly give me the following information regarding the machining of piston rings of a main engine: Size of casting from which rings must be made. How to determine the first rough machining? Amount to be cut off; kind of cut and kind of cod piece to be used? Machining to finished dimension after cut? Clearance necessary after ring is set in the cylinder bore? Suggest the best way of cutting water grooves, and if these are absolutely necessary? If springs on the back of these, what pressure would you allow? Would steam pressure be better? The conditions I am dealing with are shown in Figs. 1 and 2.

A. (997).—Unfortunately the sketches do not show the diameter of the cylinders or pistons. We may, however, assume that these are 28 inches by 45 inches by 72 inches. Your sections would indicate that a Cameron packing ring was to be used for the low pressure cylinder, and for the intermediate and high pressure two rings of uniform section which depend on the natural spring of the ring to force them out against the cylinder walls. Seaton advises that piston rings be designed so that they exert a pressure of 3½, 3 and 2½ pounds per square inch of ring surface respectively for the high, intermediate and low pressure cylinders.

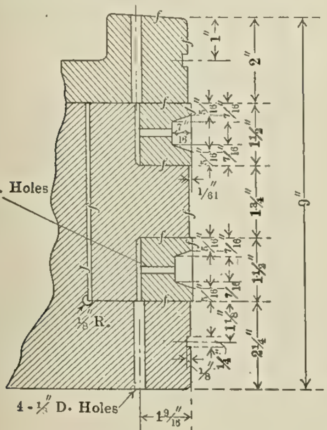


Fig. 1.—Piston Ring for High and Intermediate Pressure Cylinders

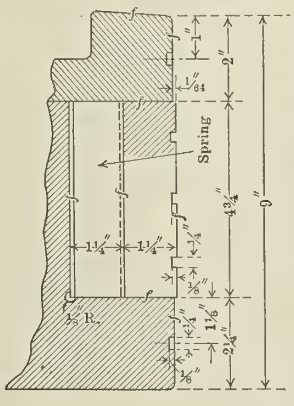


Fig. 2.—Piston Ring for Low Pressure Cylinder

The construction of the rings for the high and intermediate pressure cylinders (Fig. 1) is unusual. The bearing surface of each of these two rings upon the cylinder walls is rather small, since the effective depth is only ⅝ inch. Furthermore, it is probable that the ⅛-inch and ¼-inch diameter holes which admit steam to the back and to the front of the rings would be likely to clog with dirt or grease. Although the old method of using coach springs has several disadvantages, it is often employed for intermediate and low pressure cylinders. The high pressure piston may have Ramsbottom rings, spring rings and coach springs or be simply a plug piston machined so as to have about .005-inch clearance.

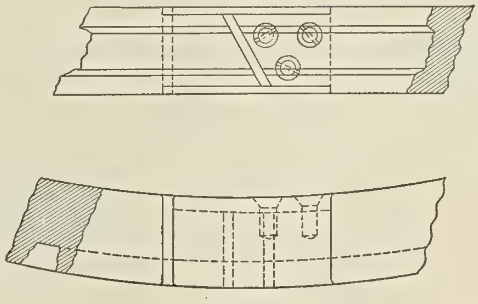


Fig. 3

Piston rings for an engine of this size may be cast to turn up ¾ inch, 7/16 inch and 5/16 inch larger than the diameter of the cylinders. Cut out a piece of the ring so that it will be slightly shorter than the circumference of the cylinder and allow for the ring's expansion. Then clamp the ring on the face plate of a lathe for the finishing cut, making it from 1/16 inch to ⅛ inch greater in diameter than the cylinder.

Fig. 3 shows a very simple means of preventing leakage by the ends of ring. Water grooves are advisable for two principal reasons—they cut down the leakage by the piston springs, and also aid in lubricating.

The dimensions shown in Figs. 1 and 2 are reasonable. There is probably no detail of marine engine design which is more open to discussion and experiment than the proper type of piston rings.

Yacht Design

Q. (998).—What books would you recommend as an aid in yacht and sailing vessel design?

A. (998).—Several very good books have been written on the design of sail yachts. "Elements of Yacht Design," by Norman L. Skene, covers the theoretical side of the subject. For racing yachts the minimum scantlings are often determined by the rules of the class for which they are designed.

To my knowledge, there is no publication which treats entirely upon the design of sailing vessels. If of large size, their scantlings will be determined by the rules of the insurance society. The amount of sail area, size of spars, etc., may be based upon some previous design which has proved satisfactory. Any good text book on naval architecture will cover the displacement and stability as well as the powering in the case of an auxiliary vessel.

Development of a Flanged Bracket

Q. (1,000).—Kindly outline a method of developing brackets connecting shell longitudinals with bulkhead stiffeners (Isherwood system), where the shell has double curvature.

A. (1,000).—It should be remarked that the construction suggested here, namely, using the stiffener bracket to serve also as stringer bracket, is not always followed. Figs. 1 and 2 illustrate the construction in question. Since

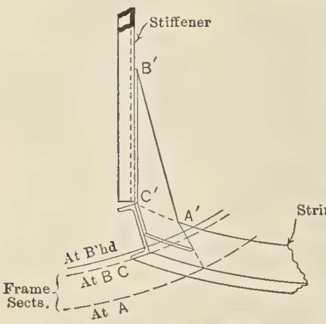


Fig. 1.—End View of Bracket

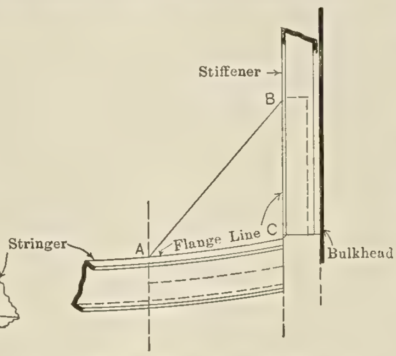
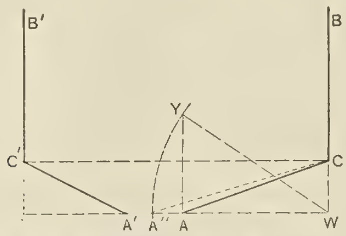


Fig. 2.—Side View of Bracket

the bracket must be flanged where it attaches to stiffener and stringer, these flange lines will be AC and BC. A template of the bracket can now be readily made on which the flange lines, angle to flange to, landing, and type of riveting to both stiffener and stringer are shown. Holes on one arm of the bracket may be left blank, if desired, until erection. The true shape of the bracket can be



End Projection. Side Projection
Fig. 3

found by obtaining the length of the sides of the triangle ABC. Side BC projects in its true length. The true length of the side AC may be obtained as follows: Draw AY (Fig. 3) perpendicular to $A'AW$ and equal to $A'X$ in length; lay off from W the distance WA'' equal to YW; then $A''C$ is the true length of side AC. In like manner the true length of AB can be found.

Cost of Vessel's Hull and Machinery

Q. (999).—Will you kindly inform me as to the relative cost of hull compared with the machinery of a vessel. Hull to include the steel hull, fittings, houses and furnishings, cargo gear; the machinery to include the propelling machinery, engine room auxiliaries and all piping. Of the above machinery cost, how much would be spent for auxiliaries, etc., purchased outside the shipyard?

A. (999).—The relative cost of machinery to hull of vessels depends upon several considerations, viz., type of machinery—reciprocating, turbine or Diesel engine—speed and size of vessel, etc. A fast vessel will require carefully designed and constructed machinery, which will add not a little to the cost; likewise, the machinery weight of a small ship will be greater in proportion to the displacement than that of a large vessel, provided the speed is the same in both instances.

For a cargo ship about 400 feet long and with reciprocating engines and Scotch boilers, the following are pre-war figures: Hull, $395,000; machinery, $155,000.

Practice varies in different American shipyards as to what amount of the machinery shall be constructed in the yard. Some companies will even undertake the manufacture of such auxiliaries as the pumps, windlass and steering gear. Should we decide that only the main engines, boilers and condenser be built at the yard, and that all auxiliaries, both engine room and deck, be bought from the manufacturers of the same, the probable cost of these would be in the neighborhood of one-sixth of the estimate for machinery and its installation. It should be noted that commonly deck auxiliaries are classed with hull outfit.

An Apprenticeship Course for Shipfitters

(*Concluded from page* 156.)

ONE MONTH.—Preparation of an estimate for work planned and routed in minute detail for shipfitting and related trades. Checking up material list showing exact shop sizes, amounts to be used and amounts of waste from commercial or standard sizes.

THREE-YEAR COURSE IN APPLIED SCIENCE (THEORETICAL KNOWLEDGE OF THE TRADE) FOR SHIPFITTERS

First Year

ONE MONTH.—Types and manufacturers' names of materials, tools and appliances. Use of the common tools, such as hammers and cold chisels.

FOUR MONTHS.—Study of the processes of drilling and reaming. Handling of different kinds of drills and reamers, rivets, and bolts; different kinds of cold chisels. Study of how these tools are made: meaning of hardening, tempering and annealing; effect of heat on metals. Principles underlying calking and very elementary principles of pneumatic tools.

FOUR MONTHS.—Study of the simple mechanical principles underlying the manipulation of hand tools, such as leverage (handles) of hammers, cutting edges (wedges), etc.

THREE MONTHS.—Descriptions and uses of measuring tools, such as metal gages, micrometers, calipers. Units of work. Specific gravity (weight of metal per square foot).

Second Year

ONE MONTH.—Study of the raw materials and processes used in their preparation—cast iron, wrought iron, steel, mild steel, high carbon steel. Special treatment of steel, vanadium and tungsten metals.

THREE MONTHS.—Study of the properties of water pressure, involving the properties of liquids applied to hydraulic machinery, such as hydraulic keel benders, etc. Buoyancy of water; explanation of "why a boat floats"; watertightness.

ONE MONTH.—Study of air pressure involving the properties of gases. Mechanism of pneumatic tools, airtight condition of compartments.

THREE MONTHS.—Explanations of the mechanism of various power tools used in building the specific hull upon which the apprentice is engaged, such as butt riveter, drill presses, punching machines and cold press.

ONE MONTH.—A short description and study of the design of a shipshape, parts and materials used.

THREE MONTHS.—The scientific principles underlying the design of a ship. The theory of displacement and buoyancy (elementary).

Third Year

SIX MONTHS.—The principles of hygiene and safety explained to apprentices. The care of the body; the kind of clothing worn; the dangers of the trade and how they may be prevented, such as falling from scaffolds. The theory of displacements and drafts under loads, center of gravity, buoyancy, inclination under weights.

FIVE MONTHS.—The principles of the strength of materials applied to iron and steel in a ship. Use of such terms as tensile, shearing and compressive strength.

ONE MONTH.—Composition of metals and alloys.

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

MILLION-DOLLAR CONTRACT FOR WARRIOR BARGES AWARDED

Bids Open for Cargo Barges for New York State Canal

On February 2, the Railroad Administration, announced the closing of the contract for four self-propelling barges of 2,200 tons, each costing $244,000, with the St. Louis Boat Engineering Company, St. Louis, Mo. At the same time twenty wooden barges of 500 tons, costing $6,000 each, were ordered from the Murnan Shipbuilding Company, Mobile. In anticipation the Murnan Shipbuilding Corporation entered into negotiations for material to build the vessels in the latter part of January. Officials of the company say it will require three months for the completion of all the barges.

There still remains the announcement of contract for three steel boats to be used in the same fleet. No official statement has been made regarding the contractor selected, but the Howard Shipbuilding Company, of Jeffersonville, Ind., is the lowest bidder, and will probably secure the order.

Details of British Shipbuilding Production

The production of ships in various parts of the United Kingdom during 1918 is shown in the following table:

	Vessels	Tons	I.H.P.
Scotland	593	633,748	1,969,670
England	599	1,029,017	2,192,056
Ireland	53	213,646	287,580

The output of the leading districts was as follows:

	Vessels	Tons	I.H.P.
The Clyde	440	555,803	1,900,595
The Tyne	111	361,165	935,956
The Wear	62	269,628	288,030
The Tees	80	227,840	297,675
Ireland	53	213,646	287,580

The production from the largest yards is as follows:

	Vessels	Tons
Harland & Wolff (three yards)	35	219,567
Harland & Wolff (Belfast only)	15	119,445
Swan, Hunter & Wigham Richardson	29	82,214
Workman, Clark & Co.	19	69,370
William Gray & Co.	16	62,058
Russell & Co.	10	59,685
William Doxford & Sons	11	44,967

German Shipbuilding During the War

Rather specific details are given out by the War Trade Intelligence Department of Great Britain regarding ship construction in Germany during the war. As reported by an employee of the Vulcan Werft, Hamburg, during the period from 1914 to 1917 this company was engaged chiefly in constructing torpedo boats and battleships.

Since the launching of the hull of the new 52,000-ton merchant ship, the *Bismarck*, in June, 1914, spare labor has been utilized in fitting out the vessel. Besides the Vulcan Werft another large shipyard has been made ready for the Hamburg-Amerika Line, where merchant ships of 10,000 tons will be built for the post-war trade. The informant reports also that at the Reihestiegwerft, Hamburg, several standard ships of 4,000, 8,000 and 12,000 tons were constructed.

(Photograph by International Film Service)

The Steamer *Taiho Maru*, Built at Osaka, Japan, Which Touched the Port of Seattle in Ballast Just Six Months After the Steel for Her Hull had Been Shipped from That Port

CONTRACTS LET FOR MISSISSIPPI BARGE FLEET

Fifty-nine Barges and Ten Towboats Will Be Used for This Service

On page 161 of this issue of Marine Engineering a complete description of the equipment for the upper and lower Mississippi barge fleet appears.

Contracts for these vessels have been let as follows:

To the Dravo Contracting Company, Pittsburgh, Pa., six 300-foot steel hopper barges; six boats of the same type to the Dubuque Boat & Boiler Works, Dubuque, Ia., and seven to the Marietta Manufacturing Company, Point Pleasant, W. Va.

Up to the present all bids have been rejected for building the four upper river towboats, which are to be 256 feet long, of steel. It is reported that these will probably be built at the Government shipyards in St. Louis.

Contracts for the forty barges used on the lower route have been let as follows:

Twenty-five to the American Bridge Company, Ambridge, Pa., and fifteen to the Dravo Contracting Company, Pittsburgh, Pa. These barges are of steel, and will be 230 feet long.

The steel towboats for the lower Mississippi route are to be built by the Charles Ward Engineering Company, Charleston, W. Va., and the Marietta Manufacturing Company, Point Pleasant, W. Va. Two of these will be constructed by the former company and four by the latter. The boats will be two hundred feet long.

CANADIAN SHIPYARDS TO BE GREATLY ENLARGED

Clyde Builders Will Shift Operations to British Columbia Coast

Yarrow & Company have officially announced that they intend gradually to diminish their output on the Clyde and develop their works on the Pacific Coast of North America. Harold E. Yarrow, managing director of the works on the Clyde, is visiting America to study conditions here.

When interviewed, officials of the company gave several definite reasons for their decision. They reported that they found it quite as advantageous to purchase steel from American mills, that transportation facilities were more advantageous, and that the labor problem was less difficult on the Pacific Coast.

BIG SHIP REPAIR PLANTS TO BE BUILT

Millions to Be Expended in Erection of Drydocks and Repair Shops at New York and Philadelphia

Plans for the erection of immense ship repair plants in both New York and Philadelphia are being made, it is rumored, by a large corporation, headed by some of the most experienced shipbuilders in the United States and backed by millions of dollars in capital.

According to reports, the plans provide for the construction of a number of large floating drydocks, together with shops and repair facilities, on the Hudson River near New York, and also on the Delaware River near Philadelphia.

The new plants will be equipped for the repair of the largest vessels afloat.

GOVERNMENT'S HUGE UNDERTAKING

Norfolk Navy Yard Will Cost Over $11,000,000

Censorship upon the building operations at the Norfolk navy yard has been lifted so that a more accurate idea of the operations being undertaken is available.

The following list of important items gives a fair idea of the work under way:

Structural steel building for the laying out of battleships, $1,400,000; new slips for the accommodation of vessels under repair, $1,200,000; new drydock No. 4, $400,000; naval hospital, $1,200,000; foundry building, $600,000; pattern shop, $400,000; power house, $700,000; lumber storage warehouse, $350,000; crane runway, $460,000; coal handling plant, $100,000; naval magazine, $410,000; central power plant, $350,000; mine-building plant, $350,000; six mine storage buildings, $50,000 each, and two storehouses, $250,000.

H. C. Higgins Succeeds Rear Admiral Bowles as Assistant General Manager of the Emergency Fleet Corporation

Howard C. Higgins, formerly representative of the United States Shipping Board Emergency Fleet Corporation at the shipyard of the Submarine Boat Corporation, Newark, N. J., and more recently representative of the Emergency Fleet Corporation at the Hog Island yard of the American International Shipbuilding Corporation, has been appointed assistant general manager of the Emergency Fleet Corporation, succeeding Rear Admiral Francis T. Bowles, resigned.

Mr. Higgins is a member of the Council of the Society of Naval Architects and Marine Engineers, and up to the time the United States entered the war had been for years superintending engineer of the Old Dominion Steamship Company, New York.

Emergency Fleet Activities Abroad

It is reported that a representative of the Emergency Fleet Corporation is in France to arrange for the selling of one of the large shipbuilding plants on the Pacific Coast. The plant is only partially completed, work having been halted at the signing of the armistice. It is also understood that the representative will seek to arrange that certain equipment suitable for shipbuilding now in France be sold to advantage.

$3,435,000 CONTRACT FOR COAST GUARD CUTTERS GOES TO WESTERN YARD

Everett, Wash., Shipyard to Build Five Before April 1, 1920

As announced in brief in the February issue, the Navy Department has signed one of its largest contracts with the Norway Pacific Construction & Dry Dock Company, Everett, Wash., for the construction of five coast guard cutters at a total cost of $3,435,000. The bid of this company was about $12,000 lower than any competitor. The contract calls for the delivery of the ships between December 1, 1919, and April 1, 1920. Olaf Hetlesater, naval architect of the company, is now planning the work, so that it can be rushed as soon as the first steel shipments are received. It is expected that the first keel can be laid about March 15.

FOUNDATION COMPANY BIDS FOR FOREIGN CONTRACT

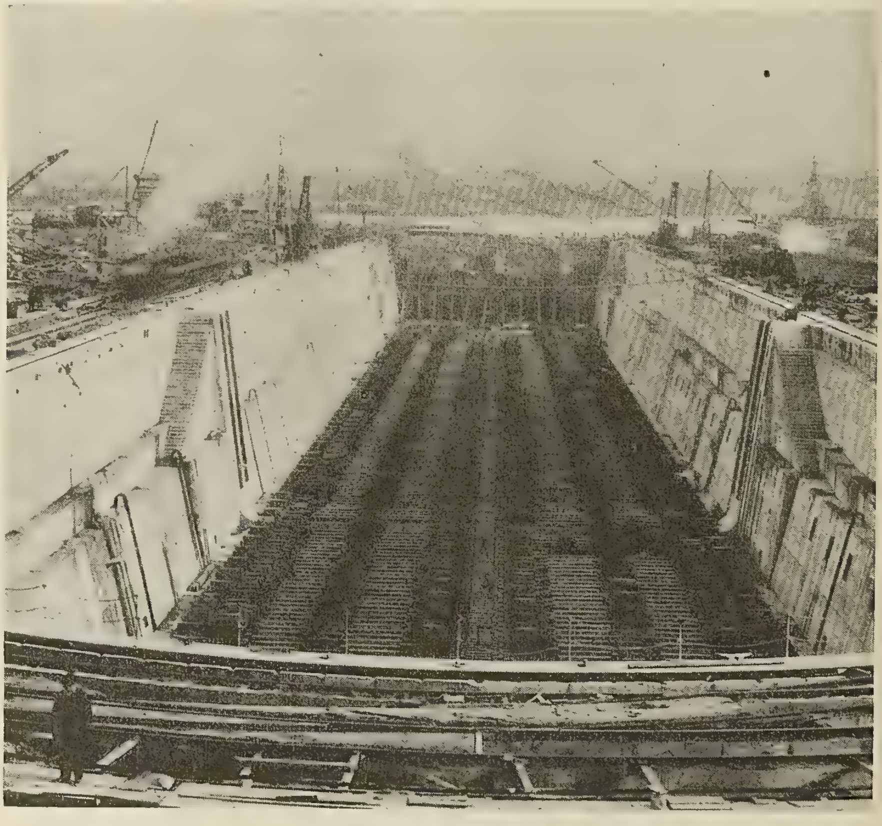
Large Contract Awaits Government Approval

It is stated that contracts have been secured by the Foundation Company, 233 Broadway, New York, from the French Government totaling $200,000,000. All negotiations await the approval of the United States Government. The contract calls for 174 steel cargo vessels. The report is not denied by the Foundation Company.

The Foundation Company is still endeavoring to have the yards at Tacoma and Portland opened for private contracts. So far the Government has declined to allow the company to build for foreign account, although Government contracts are withheld. For this reason the company was compelled to establish its shipbuilding yard at Victoria, B. C., where twenty 3,000-ton twin-screw wooden steamers are being built for the French Government. The company gives out the information that four foreign governments are negotiating for the establishment of shipyards under Foundation Company control in their respective countries.

New Ships for the Cunard Line

Sir Ashley Sparks, on his arrival at New York, announced that the Cunard Line had mapped out a ten-year building programme, and would construct ships of the type of the *Tuscania* and *Franconia,* of 14,000 and 18,000 gross tons, respectively.



The Norfolk Drydock, Largest in the World, Opened on February 1

SHIPYARD IMPROVEMENTS

New England States

The Machias Ship Construction Company, Machias, Me., is making over the steel coal barge *Coastwise* into a sailing vessel. This vessel is the third of a fleet of colliers sailing along the New England coast which are being made over into full rigged ships.

Contract has been let for a new machine shop for the Navy Department, Portsmouth, N. H., aggregating $122,906.

The Fore River Shipbuilding Corporation, Quincy, Mass., including the branch plant at Squantum, is now giving employment to over 25,000 men. The plant is said to have orders on hand to allow for full operations throughout the coming year.

The Boston Dry Dock & Shipbuilding Company, Jeffries Point, East Boston, is preparing to build a ship repairing plant costing $6,000,000.

The Marine Engineering & Dry Dock Company, Providence, R. I., is planning to build a ship repair plant and several drydocks.

The Crowninshield Shipbuilding Company, Providence, R. I., is said to be considering the building of a new marine railway of 3,500 tons capacity at the South Somerset yard.

The Narragansett Shipbuilding Company, Tiverton, R. I., is building a 20,000-ton drydock to cost around $1,000,000, including equipment. The contract has been placed by the Shipping Board; the new drydock will be operated at New York.

Middle Atlantic States

The Marine Construction Company of New York has launched a sectional dock, 120 by 85 feet, with 16-foot depth, at Bartow, Fla. Three additional docks will be built. It is planned to tow these to New York.

The Westinghouse Electric Company is planning to quadruple the present capacity of the Essington plant. The company still holds contracts for equipping 150 of the Emergency Fleet Corporation's ships with Westinghouse propelling machinery.

The Hudson Shipbuilding Corporation are contemplating making a one-story addition to their plant which will cost about $20,000.

Three new ways have been built at the Bethlehem Shipbuilding Corporation at Sparrow's Point, and the Union Shipbuilding Corporation at Fairfield are planning to build six ways in addition to the four now under construction.

Plans for a two-story brick and concrete office building, to be erected at the Sparrow's Point plant of the Bethlehem Shipbuilding Corporation, are perfected by the company's architect, Edward L. Palmer, Jr.

The Bethlehem Shipbuilding Corporation is also planning the erection of a pumping plant to cost $25,000 at its Sparrow's Point, Md., yard.

The shipyard being built under the direction of the Emergency Fleet Corporation, Washington, D. C., at the upper end of Gloucester City, N. J., will be ready for operation early in March, by the New York Shipbuilding Corporation, Camden, N. J., as an extension to its present works. The plant will cost about $10,000,000, covering a site of about 50 acres on the Delaware River. About 4,000 men will be employed at the yards. Among the structures now nearing completion are a plate and angle shop, about 200 by 780 feet, four general works buildings, each about 100 by 500 feet, and a brick and steel storehouse. Considerable machinery and equipment are being installed in different sections of the plant. The shipyard has been constructed by the Hugh Nawn Construction Company, Boston, Mass.

The Traylor shipyard at Cornwells, Pa., operated by the Traylor Engineering & Manufacturing Company, Allentown, is planning to establish a permanent shipbuilding plant after the Government orders, now building, are completed.

The Chester Shipbuilding Corporation, Chester, Pa., is planning to build a two-story shop to cost about $25,000.

The ship chandlery business of the Bie & Schiott Company, Inc., Philadelphia, Pa., has been taken over by the Norden Ship Supply Company, recently organized. H. Gulbranson, I. Westergaard and P. L. Bjornsgaard are connected with the new company.

The Navy Department is planning to build an addition to the machine shop at Indian Head, Md.

The Bureau of Yards and Docks, Washington, will build an electric substation for operation at Piers A and B, League Island, Philadelphia, Pa. It is understood that extensions will be made in a number of shop buildings at the yard to increase the present facilities.

The Pusey & Jones Company, Gloucester City, N. J., has recently consolidated operations at its New Jersey shipyard, following the issuance of orders about the middle of February, covering the suspension on plant construction, then under way, and on ships known as C-13 to C-19, and H-204 to H-212. The plate and angle shop and the mold loft at the New Jersey yard have been closed down temporarily. It is reported that the Emergency Fleet Corporation will probably turn over the plant to the private company. Under these conditions the plant will be immediately started up for the construction of a number of vessels for private interests, contracts for which, it is understood, have recently been received. The bulk of production up to the present time has been devoted to oil tankers of 7,000 tons capacity.

The Federal Shipbuilding Corporation, Kearny, N. J., a subsidiary of the United States Steel Corporation, has its twelve shipways occupied at the present time by vessels under construction for the Emergency Fleet Corporation. With previous deliveries, the company's contract with the Government calls for the construction of ten steel vessels in addition to the twelve now being built. It is planned to complete three of these vessels early in April and, closely following, to inaugurate construction work on steel freighters and ships of other types for private interests. The first three vessels to be built at the yard will be designated for use by the parent corporation. The plant is now giving employment to close to 9,000 men.

The Submarine Boat Corporation, Port Newark, Newark, N. J., is now giving employment to about 12,500 men, and it is proposed to increase this number to a total of over 15,000 at an early date. The company has a contract covering the building of 150 steel vessels for the Emergency Fleet Corporation, each of 5,500 tons capacity, an order for fifty being signed in September, 1917, and supplementary contracts bringing the total up to the amount noted. It is planned to bring production at the plant up to a maximum capacity of twelve launchings a month during the coming summer.

A one-story addition, costing about $10,000, is being begun by the Sun Shipbuilding Company, Chester, Pa.

Southern States

The Mobile Shipbuilding Company, Mobile, Ala., has increased its capital stock from $1,000,000 to $5,000,000.

The Colonial Marine Railway Corporation, of Norfolk, Va., has increased its capital to $500,000. Another Virginia company located at Weems, Humphreys Marine Railways & Lumber Corporation, has increased its capital stock from $25,000 to $75,000. The company will build a 1,000-ton marine railway and install machinery, including crude-oil engine, with generator to operate two marine railways of 500 to 1,000 tons capacity and other machinery.

The Marietta Manufacturing Company, Point Pleasant, W. Va., will build an addition to its marine ways in order to provide facilities for constructing the river barges to be built for the Government.

The Fred T. Ley Company, Mobile, Ala., main office, Berkeley Arcade, New York, has begun the construction of concrete vessels. Two boats are now being erected at the present time, with plans for launching in March. It is understood that a number of such boats will be constructed at the works, maintaining operations at normal.

The International Shipbuilding Company, Pascagoula, Miss., the capacity of whose yards now permits them to build ten steel vessels at once, are planning to enlarge their plant as soon as possible. They are also arranging to construct a railroad which will connect the shipbuilding plant with a new waterfront terminal to be constructed in the near future.

The McBride & Law Company, of Beaumont, will build a drydock at Port Arthur.

The Foundation Company, 233 Broadway, New York, has recently completed the erection of a new electric power plant for works operation at its yards at Savannah, Ga.

The Norfolk Shipbuilding & Dry Dock Company, Norfolk, Va., has broken ground for the construction of two additions to its plant on Argyle avenue, for increased facilities.

A one-story machinery warehouse has been contracted for by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va.

The Navy Department will shortly issue a list of cranes to be installed in the armor plate plant now under construction at Charleston, W. Va.

Western States

Upon a 40-acre site provided by Kewaunee, Wis., work will soon be begun by the Wisconsin Shipbuilding & Navigation Corporation upon a new shipbuilding plant. Facilities will be provided for building six 3,500-ton vessels per year suitable for Great Lakes and ocean service.

Bids will be opened after February 21 to build a floating drydock to cost about $400,000 at Green Bay, Wis. F. Early, of Chicago, is the engineer who has prepared the plans.

The Dubuque Boat & Boiler Works, Dubuque, Ia., is building two coast guard cutters for the United States Navy, Nos. 32 and 34. These boats, which are of 34-foot beam, 179 feet long and 3-foot draft, are stern-wheel vessels.

Side by side with the development of larger vessels, reports from Seattle show that many small fishing boats will be constructed in Tacoma before the spring. Inquiries have even been received from Eastern companies, which show how tied up Eastern yards are for this type of building.

A new track will be built at the Pacific Coast Shipbuilding Company's yard on the upper Suisun Bay. Space is also being cleared for an addition to the warehouses of 100 by 100 feet. It has been necessary to enlarge the housing and sleeping facilities to accommodate the men now employed. The 110-room hotel will cost about $150,000.

The Astoria Marine Iron Works, Astoria, Ore., it is reported, will be developed into a steel plant for the fabrication of marine and structural iron. Plans for a marine railway of 6,600 tons have already been approved. The present buildings and facilities are also to be enlarged.

Reports show that repairs on marine work are increasing in the Tacoma plant of the Coast Iron & Machine Works, which is engaged in all types of machinery installation work for that district.

Several shipyards in the California district are reported as buying machine shop equipment for installation at the yards.

Canada

The National Shipbuilding Company, Goderich, Ont., are in the market for new machine shop equipment.

The Prince Rupert Shipbuilding & Engineering Company, Prince Rupert, B. C., has been organized to build steel ships, with a capitalization of $500,000. J. L. Mullen, of the Mullen Construction Company, Pittsburgh, Pa., is president.

Plans for a new shipyard at Vancouver, B. C., are being made by the Foundation Company through the manager of the proposed works, Bayley Hipkins.

A new boiler house and other extensions are planned by the Dominion Shipbuilding Company of Toronto, Canada.

With the capitalization of $100,000, the Watson Dry Dock & Construction Company plans to build a floating drydock and shipbuilding plant at Victoria, B. C. Small vessels of 300 tons, tugs and scows will be repaired and equipped.

A boatbuilding firm at Shelburne, Nova Scotia, is now filling an order for seventy lifeboats, to be 20 to 24 feet long, and many dories. A recent shipment included 100 dories sent to St. Pierre.

Plans are in progress for an addition to the shipbuilding plant of the Western Canada Shipyards, Ltd., Carroll street, Vancouver, B. C., to cost $43,500.

Foreign

The Kawasaki Dock Company, of Kawasaki, Japan, has increased its capital stock to $24,000,000. The greater part of the new stock is being given to faithful workmen of the concern. The president of the company, K. Matsukata, has announced the establishment of the Daifuki Steamship Company in Japan, with a capital of $9,960,000.

The Harland & Wolff Company, Belfast, it is reported, has purchased the steel works of David Colville & Sons, Ltd., of Motherwell and Glengarnock, Scotland, with a view to having first call on their steel production.

To make the Swedish industry independent of foreign supplies a new company has been formed at Gothenburg, with a capital of $7,500,000, for the manufacture of ship and marine engine specialties.

The Schichau Shipbuilding Works, one of the most important in Germany, has been sold to an American concern for 160,000,000 marks ($40,000,000), according to recent newspaper reports.

Floating Drydock for Hoboken

W. & A. Fletcher Company, Hoboken, N. J., will construct a huge floating drydock, to cost about $1,500,000. In addition, a large plate shop will be started on the block between Fourteenth and Hudson streets.

HARBOR IMPROVEMENTS

Atlantic Coast

The Dominion Government of Ottawa has voted $50,000 for waterfront improvements.

A petition to appropriate $500,000 for improving East Boston ferry slips has been entered before the State Legislature. Petition is also being forwarded to authorize the dredging of the Mystic River from the creek to the sea, and for the building of docking facilities.

The New York State Legislature has received a petition for the appropriation of $950,000 to build extensive canal terminals at Kingston, Newburgh, Poughkeepsie and Yonkers. Separate petitions have been issued by Waterloo and Seneca Falls, N. Y., of $100,000 each for terminal barge facilities at these ports.

It is planned to widen the harbor of Norfolk from Hampton Roads to Elizabeth River Belt Line.

On February 3, the New London City Council, New London, Conn., approved a petition to the State Legislature for authority to issue $1,000,000 in bonds for waterfront improvements.

Arrangements are being made for the bonding of the city of Pascagoula, Miss., for $100,000, to be utilized for port improvements along the 800-foot waterfront owned by the city.

The Navy Department plans to build a timber wharf at Norfolk, Va., to cost $55,000.

A movement is on foot to jetty Cape Fear bar to obviate the continuous dredging, which is necessary at present.

The Texas Oil Company has applied to the City Commissioners of Pensacola, Fla., to build a wharf, which will be 1,830 feet long, 30 feet wide, and with a frontage of 480 feet and an extension to the eastward of 600 feet.

The cities of Galveston, Texas City, Houston, Port Aransas, Beaumont, Orange and Port Arthur have formed a commercial association to further questions of trade and harbor improvement.

The City Commission of Jacksonville, Fla., has been authorized to secure a first-class fireboat, to be purchased at an expense of not over $150,000. A naval architect will be selected for the drawing up of the plans at once.

The Navy Department has issued plans for waterfront improvements at Key West costing $1,676,000.

Tampa, Fla., is arranging to construct a slip and an improved pier which will cost about $180,000.

Authorization by the Federal Government for the construction of a 5,000-ton drydock at Pensacola has been reported.

Work on the North Charleston terminal facilities will be completed about April 1. The cost will reach about $17,000,000. The improvements will include six covered warehouses 1,200 feet long. The docks accommodate the largest ocean vessels.

Within the past three years Portland, Ore., has voted $8,000,000 for port improvements. The last bond issued was authorized on November 6, 1918, for $5,000,000. The previous $3,000,000 issued is being used in the construction of a grain elevator and for port improvement in the vicinity.

Pacific Coast

Pier No. 1 at Portland was opened for business on February 8. The covered section of the pier extends 600 feet inshore from the harbor line. It is two stories in height.

Astoria, Ore., plans to sell $750,000 in bonds for port improvements, including a one-mile belt extension, large warehouse, dredging of the Skipanon River, and providing side tracks at port terminals.

The Board of State Harbor Commissioners of California is about to let contracts, amounting to about $2,000,000, to improve the port of San Francisco. Among the projects are: Building six double-decked bulkhead warehouses, intended primarily for foreign trade; extension of the present seawall along the front between the piers; extension of several piers to full length allowed by Government; a 500-foot pier to replace old Pier No. 1, to be built by H. B. Hanna Company, and the installation of modern cargo-handling equipment on the harbor docks.

Contract has been signed by the Seattle Commission with the firm of Harrington & Peters for the construction of the sub-structure of the new Smith-Cove terminal, known as Pier B, which calls for an expenditure of $567,600. The commission has also drafted a petition to the United States engineer asking for permission to extend the Smith-Cove harbor line approximately 50 feet.

A contract has been let for the construction of a huge pier on Smith Cove, Seattle, which will cost about $2,300,000.

The contemplated harbor development at Tacoma, Wash., will embrace the building of piers and slips on the Herring plan. A waterway 1,000 feet wide is to be maintained, with piers and slips at an angle of 45 degrees and 800 to 900 feet long.

Preliminary plans for dock and warehouse improvements to be constructed at Tacoma, Wash., were brought before the Pierce County Port Commission on January 29. Frank A. Walsh is the chief engineer.

J. B. Hegardt, of Portland, Ore., is arranging to build a $900,000 dock for the city of Portland on the St. John's municipal terminal. The construction will be of wood of 12,000-ton capacity. It is understood that bids are now open.

Baltimore will have a new $100,000 pier as planned by the Standard Oil Company to replace the pier now handling the work. Thomas Goodwillie, Pier 2, Pratt street, wharf, is engineer in charge.

Funds are now available for the dredging of the Willapa River, Raymond, Wash.

Oregon Will Use $5,500,000 for Building Port Improvements

Five and one-half millions of dollars are available for use in connection with the expansion of port facilities in Portland, Oregon. Among other improvements it is planned to construct a 12,000-ton drydock and an additional pier, 1,500 feet long.

Mechanics' Liens Placed on Atlantic Corporation Steamers

Creditors of the Atlantic Corporation, Portsmouth, N. H., are co-operating with the shipbuilders in a suit to compel the Emergency Fleet Corporation to pay a "fair price" for the construction of ten steel steamers, which the corporation has contracted to build, or to cancel the contract. Mechanics' liens have already been placed upon the hulls of six steamers now in the course of construction. The total amount of outstanding indebtedness, according to the officials of the Atlantic Corporation, is $609,000.

Marine Boiler Shop at Richmond

Work upon the marine boiler plant which will be built at Richmond, Va., for the Newport News Shipbuilding & Dry Dock Company is to be resumed. Temporary suspension of building plans followed the signing of the armistice. Orders for cranes and plate-working machinery, which were included in the original specifications, will doubtless be reinstated.

LAUNCHINGS OF THE MONTH

Date of Launch	Name of Vessel	Deadweight Tonnage	Type	Builder	Owner
Jan. 29	Fort George	3500	Ferris Wood	J. M. Murdock, Jacksonville	Emergency Fleet Corporation
Jan. 29	Unnamed		Concrete Barge	Liberty Shipbuilding & Transportation Co., Cleveland	Emergency Fleet Corpoation
Jan. 30	Farnan	5000	Steel Cargo	Submarine Boat Corporation, Newark	Emergency Fleet Corporation
Feb. 1	Osconda	8800	Steel Cargo	Baltimore Dry Dock & Shipbuilding Co., Baltimore	Emergency Fleet Corporation
Feb. 8	Laurel	6200	Steel Cargo	Baltimore Dry Dock & Shipbuilding Co., Bzltimore	Emergency Fleet Corporation
Feb. 1	Walden	9000	Steel Cargo	Newburgh Shipyards, Inc., Newburgh	Emergency Fleet Corporation
Feb. 3	Thomas W. Lipton	2000	Schooner	Brunswick Marine Construction Co., Brunswick, Ga	Apex Navigation Corporation
Jan. 30	Ganeri	3500	Ferris Wood	Housatonic Shipyards, Stratford,	Emergency Fleet Corporation
Jan. 30	Tuckanuck	9400	Steel Cargo	Moore Shipbuilding Co., Oakland, Cal.	Emergency Fleet Corporation
Jan. 30	Bon Secour			Pacific American Fisheries Co., Bellingham, Wash,	Emergency Fleet Corporation
Jan. 29	West Selene	8800	Steel Cargo	Los Angeles Shipbuilding & Dry Dock Co., San Pedro,	Emergency Fleet Corporation
Feb. 1	West Capance	8800	Steel Cargo	Los Angeles Shipbuilding & Dry Dock Co., San Pedro,	Emergency Fleet Corporation
Feb. 27	West Sequona	8800	Steel Cargo	Los Angeles Shipbuilding & Dry Dock Co.	Emergency Fleet Corporation
Jan. 30	Serritor	3500	Ferris Wood	Benicia Shipbuilding Co., Benicia, Cal.	Emergency Fleet Corporation
	Horado	3500	Ferris Wood	National Shipbuilding Co., Orange, Texas,	Emergency Fleet Corporation
Jan. 29	Hegiria	1300	Steel Cargo	Bethlehem Steel Corporation, Alameda, Cal.,	Emergency Fleet Corporation
	Bob-o-link	....	Mine Sweeper	Baltimore Dry Dock & Shipbuilding Co., Baltimore, Md.,	Navy
Feb. 2	Duquesne	9600	Steel Cargo	Federal Shipbuilding Co., Kearny,	Emergency Fleet Corporation
Feb. 5	Cormorant	....	Mine Sweeper	Todd Shipbuilding Co., Brooklyn, N. Y.	U. S. Navy
Feb. 8	Fore Pierce	3500	Ferris Wood	St. John's River Shipyard Co., Mobile	Emergency Fleet Corporation
Jan. 28	West Togus	8800	Steel	Northwest Steel Co., Portland,	Emergency Fleet Corporation
Feb. 12	Oration	3500	Ferris Wood	Traylor Shipbuilding Co., Cornwalls	Emergency Fleet Corporation
Jan. 25	Farquhar	....	Destroyer	Bethlehem Shipbuilding Corporation, Sparrows Point	U. S. Navy
Feb. 6	Fleurus	....	Mine Sweeper	Foundation Company, Savannah,	French Government
Feb. 8	Octoraro	1200	Schooner Barge	Coastwise Shipbuilding Co., Locust Point,	Philadelphia & Read. Transp. Co.
	Altura	3500	Ferris Wood	Ship Construction & Trading Co., Stonington, Conn.,	Emergency Fleet Corporation
Feb. 1	West Catanace	8800	Steel Cargo	Southwestern Shipbuilding Co., East San Pedro,	Emergency Fleet Corporation
Feb. 27	West Sequana	8800	Steel Cargo	Southwestern Shipbuilding Co., East San Pedro,	Emergency Fleet Corporation
Feb. 22	Yomachichi	9500	Steamer	Oscar Dnaiels Co., Tampa, Fla.,	Emergency Fleet Corporation
Feb. 4	Randfontein	1200		Marine Const. Co., St. John, N. B.,	
Feb. 8	Nesco	5500	Steel Cargo	Submarine Boat Corp., Newark, N. J.,	Emergency Fleet Corporation
Feb. 8	Jekyl	5500	Steel Cargo	Submarine Boat Corp., Newark, N. J.,	Emergency Fleet Corporation
Feb. 10	Magenta		Mine Sweeper	Foundation Co., Savannah	French Gov't.
Feb. 12	Lotgrier		Mine Sweeper	Foundation Co., Savannah	French Gov't.
Feb. 15			Mine Sweeper	Foundation Co., Savannah,	French Gov't.
Feb. 8	Steamer No. 753	3500	Ferris Wood	American Shipbuilding Co., Lorain, O.,	Emergency Fleet Corporation
Feb. 6	Woodbury		Torpedo Boat Dest.	Bethlehem Shipbuilding Corp., Sparrows Point, Md.,	U. S. Navy
Feb. 4	Alcis		Wood	Grant, Smith-Porter Ship Co., St. Johns	Emergency Fleet Corporation
Feb. 8	Unnamed	3500	Ferris Wood	American Shipbuilding Co., Lorain, O.	Emergency Fleet Forporation
Feb. 15	Passaic Bridge	5500	Steel Cargo	Submarine Boat Corp., Newark, N. J.,	Emergency Fleet Corporation
Feb. 15	National Bridge	5500	Steel Cargo	Submarine Boat Corp., Newark, N. J.,	Emergency Fleet Corporation
Feb. 15	Masca	5500	Steel Cargo	Submarine Boat Corp., Newark, N. J.,	Emergency Fleet Corporation

WAGE SCALE READJUSTED ON ATLANTIC AND GULF COAST

Opportunities for Soldiers and Others in the New Marine Service

Award was made on December 30 covering a new scale of wages to go into effect on vessels of the Atlantic and Gulf Coast for licensed officers in deck and engine rooms. Some honest confliction of opinion had arisen after the signing of the armistice as to the application of the wage scale then in force, which led to the settlement of the terms as given below. This award becomes mandatory upon all vessels owned or requisitioned by the United States Shipping Board. The Board has also urged that private owners and operators of vessels not requisitioned pay these wages voluntarily, in order that conditions in the industry may continue stable. The rates, which became effective on January 1, will remain in full force until May 1, 1919. Since the Shipping Board has not issued wage scales on the Great Lakes or the Pacific Coast, wages in these fields are settled by private arrangement.

The classes of vessels upon which wages shall be based are as follows:

CLASSIFICATION BASED ON POWER TONS (FIGURES ARE INCLUSIVE)

Classes	Single Screws	Twin Screws
A	Over 20,001	Over 15,001
B	12,001 to 20,000	9,001 to 15,000
C	7,501 to 12,000	5,501 to 9,000
D	5,001 to 7,500	3,501 to 5,500
E	Below 5,001	Below 3,501

The wages for licensed officers are as follows:

	A	B	C	D	E
Masters	$375.00	$337.50	$325.00	$312.50	$300.00
Chief engineer	287.50	268.75	250.00	231.25	212.50
1st officers and 1st assistant engineers	206.25	200.00	193.75	187.50	181.25
2d officers and 2d assistant engineers	187.50	181.25	175.00	168.75	162.50
3d officers and 3d assistant engineers	168.75	162.50	156.25	150.00	143.75
4th officers and 4th assistant engineers	150.00	143.75			
Junior engineers	125.00				

The above rates are flat, and do not contemplate the payment of bonuses in any form whatsoever.

From the above information, the possibilities for lucrative employment for those who wish to "follow the sea" are evident. Many men released from the service, who have acquired the "wanderlust," are enlisting in the merchant marine. Offices of the Shipping Board in all large seaports seem to be swamped with applications. The men in training, while rated as apprentices, receive $30 per month with food, quarters and uniform. Under the May, 1918, ruling the pay for those branches of the service noted below serves to emphasize the good openings available:

DECK DEPARTMENT

Rating in Service	Pay Per Month
Carpenter	$90.00
Carpenter's mate	85.00
Boatswain	85.00
Boatswain's mate	80.00
Quartermaster	77.50
Able seaman	75.00
Ordinary seaman	55.00
Deck boy	40.00

STEWARD'S DEPARTMENT

Chief steward	$100.00 to $145.00
Chief cook	100.00 to 120.00
Baker	95.00 to 105.00
Second cook	90.00
Second steward	85.00
Butcher	85.00
Second baker	75.00
Storekeeper	75.00
Pantryman	65.00
Vegetable cook	65.00
Third cook	60.00
Messman	60.00
Scullion	60.00
Messboy	55.00

ENGINE ROOM

Oiler	$80.00
Water-tender	80.00
Engine room storekeeper	80.00
Fireman	75.00
Coal-passer	65.00
Wiper (on oil burners)	65.00

The applicant must be: (1) An American citizen; (2) between the ages of 18 and 35, inclusive; (3) physically sound; (4) at least 5 feet 4 inches in height; (5) not less than 125 pounds in weight for deck service, or 140 pounds for engine room work. Men trained by the Shipping Board must agree to serve for one year from the date of their acceptance for training. In arranging the trips, in so far as it is possible, the men are shipped to different ports on each voyage so that they may have an opportunity to see the world.

A new schedule of wages has been adopted by the Marine Engineers' Beneficial Association, to apply on boats operating on the Great Lakes. The schedule calls for an advance of wages on passenger boats and lumber-carrying steamers. On bulk freight steamers on which engineers are employed by the season little change will be made. Details of the schedule will be published as soon as conferences have been held with boat owners.

American Army Will Use Rotterdam and Antwerp

Rotterdam and Antwerp will be used as base ports for the American army of occupation. Warehouses will be erected here, and ships will be unloaded and reloaded upon deep draft brages which formerly belonged to the German Empire.

Yearly Report of Great Lakes Traffic

According to the annual report of the Lake Carriers' Association, although Government purchase for ocean service took eleven ore carriers from the lakes at the beginning of the season, and twelve more were removed through other sales and various causes during the year, the fleet moved 107,146,242 net tons of ore, coal and grain. While this is a decrease of 1,205,357 as compared with 1917, the report points out that the navigation season was of but little more than seven months' duration, and that at no time were water levels favorable to maximum movement.

Ten Large Vessels Sought

Inquiry has been received by Marine Engineering for vessels as follows:

Four of 10,000 tons deadweight, for passenger and freight service like the Lamport & Holt ship *Vauban*, to make fifteen knots; three cargo ships, of 4,000 tons deadweight, to make about twelve knots; two passenger and freight vessels, of about 1,000 tons deadweight each, of sixteen or seventeen knots. Those offering bids should be in a position to deliver the vessels in from twelve to enghteen months.

The contracting parties are also ready to purchase for cash at once one cargo steamer, 8,000 to 8,600 tons deadweight. Kindly forward bids at once, care of Marine Engineering, specifying details, cost, terms of payment, time of delivery and other necessary information.

Ship Contracts of the Month

Bids were closed on February 18 for the construction of twenty steel combination power and cargo barges for the New York State Barge Canal. The awards have not yet been announced.

The Todd Shipyards Corporation, 15 Whitehall street, New York, has received an order from the United States Navy Department to build six self-propelled steel oil barges.

Charles H. Tonney & Company, of Hampton, Vt., has obtained a contract for three 4,000-ton freight steamships.

The Toyo Kisen Kaisha announces that two new liners will be constructed for service on the Pacific of 33,428 tons displacement.

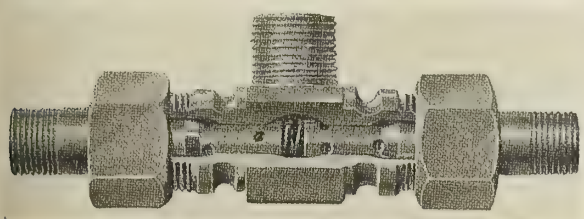
Yards Affected by Recent Cancellation of Ship Contracts

The complete list of plants receiving suspension orders, and the number of vessels upon which operations were suspended in the last ruling of the United States Shipping Board, is as follows:

Chester Shipbuilding Company, Ltd., Chester, Pa., 7; Terry Shipbuilding Corporation, Port Wentworth, Savannah, Ga., 5; Mobile Shipbuilding Company, Mobile, Ala., 12; American International Shipbuilding Corporation, Hog Island, Pa., 20; Merchant Shipbuilding Corporation, Harriman, Pa., 20; Ames Shipbuilding & Drydock Company, Seattle, Wash., *; J. F. Duthie & Company, Seattle, Wash., 3; Todd Drydock & Construction Corporation, Tacoma, Wash., 12; Los Angeles Shipbuilding & Drydock Company, San Pedro, Cal., 10; Long Beach Shipbuilding Company, Long Beach, Cal., 6; Hanlon Drydock & Shipbuilding Company, Oakland, Cal., 6; Western Pipe & Steel Company of California, South Francisco, Cal., 4; Southwestern Shipbuilding Company, Long Beach, Cal., 8; Albina Engine & Machine Works, Inc., Portland, Ore., 4; Northwest Steel Company, Portland, Ore., 8; Columbia River Shipbuilding Corporation, Portland, Ore., 4.

Automatic Relief Valve for Steam Cylinders on Ship Auxiliary Machinery

The Dew automatic relief valve, manufactured by the Dew Valve Company, Inc., 149 Broadway, New York, for draining steam cylinders is especially useful on auxiliary ship machinery, such as winches, windlasses, pumps, etc., where the saving of fuel and fresh water is of prime importance. The valves completely drain all condensation in each cylinder at every stroke, as the valves are automatic in their action, and

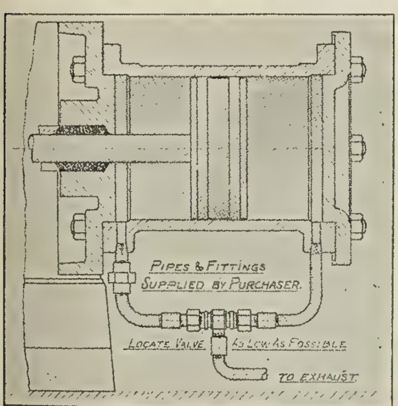


Section of Dew Automatic Relief Valve

when steam is on the one end of the valve the other is open to drain. This operation is continuous as long as the winch is in operation. When the winch is idle the spring inside the two valves in the body casting forces both valves open, so that both ends of the cylinder are drained simultaneously. By connecting the exhaust from each valve to the main exhaust line for the winches all condensation is piped back to the condenser or receiving tank, thus saving fresh water.

The Dew valve is applicable for all auxiliary machinery for both marine and stationary plants.

The valve consists of a main brass casting, having two inlets for receiving



Installation of Relief Valve

the drain pipes from each end of the cylinder, and one outlet for receiving the pipe for carrying the drainage to the exhaust pipe line or overboard.

Inside of the main casting there are two brass valves, each with a conical seat and of sufficient length so that both valves cannot seat at the same time. The heads of each of these valves are solid, to take the steam pressure from the cylinder, but the stems of the valves from the face of the valve to the other end are hollow, with small holes in each to take the condensation from the cylinder when the valve is opened by the compression spring inserted in them. The spring is placed in these valves to insure both being opened when no steam is on the cylinder. The seating of one valve insures the opening of the other when steam is on, as the valves are made of such length that the two cannot seat at the same time.

In each end of the main casting there is a brass ferrule, held in place by a brass hexagon nut, screwed to the body casting. These ferrules project beyond the nuts a sufficient distance to permit of attaching the drain pipes from each end of the cylinder.

It is obvious that in ship work, where time is a great factor, this valve would save many times its cost by insuring the safety of the winches alone from the possibility of burst cylinder heads and attending damage caused by water in the cylinders. There are no stems to be bent by cargo handling and no valves to be packed. By taking care of all condensation it is unnecessary to spend the usual time to warm up the winch before handling cargo.

These valves are in use on auxiliary machinery on ships of the Standard Oil Company, Pan-American Steamship Company, Southern Pacific Steamship Company and others.

Demand for Grey Iron Ship Castings Met by Central Foundry Company

Lack of standardization in ship fittings, and the frequent changes which were made in ship design in the early days of the development of the emergency fleet, created a demand for a great variety of ship castings which existing facilities were inadequate to produce. To meet this demand the Central Foundry Company, New York, a year and a half ago started to make ship castings. Since that time the company has kept pace with the many varied demands in casting design and construction, as is substantiated by the fact that Central Foundry castings have been installed on over 322 ships, nearly all of which were for the Emergency Fleet Corporation. The United States Navy also purchased 62 tons of 30- and 48-inch cleats from this company.

The products of the Central Foundry Company include air extractors, mushroom ventilators, bitts and bollards, chocks, cleats, davit steps, fair leaders, mooring ports and rings, cavel chocks, chain pipe, hawse pipe, bilge and ballast flanged pipe, coal and deck scuttles, sheaves, housings and windlasses. Some of the shipyards supplied with these castings were the Federal Shipbuilding Company, Kearney, N. J.; Groton Iron Works, Groton, Conn.; National Ship Building Company, Orange, Tex.; Submarine Boat Corporation, Newark, N. J.; Merrill-Stevens Company, Jacksonville, Fla., and the Bayles Shipyard, Port Jefferson, N. Y.

Dunn Stockless Anchor

The stockless anchor, first designed in 1889 by H. O. Dunn, now a rear-admiral in the United States Navy, has demonstrated through years of service on all types of vessels that it holds fast under the most severe conditions. The crown and flukes are an integral steel casting into which is inserted the shank. The casting may rotate 90 degrees with respect to the shank, the elongated crown acting as a stock and providing a horizontal position for the flukes. Each fluke presents a large holding surface, and both flukes bite when any strain comes on the cables, thus giving tremendous holding power.

The Dunn anchor is drawn into and against the hawse pipe, the crown and flukes stowing snugly against the side of the ship and being kept rigidly in place by the tension of the chain. Thus it is ready for instant service in fair weather or foul, and does away with the laborious and often difficult process of catting an anchor on deck. Should a ship not be provided with a hawse pipe, however, the Dunn anchor can be supplied with a balancing band, which makes it exceptionally easy to cat and stow the anchor.

Dunn stockless anchors are approved by and pass all prescribed tests of the American Bureau of Shipping, Bureau Veritas, Lloyd's Register of British and Foreign Shipping, and the United States Navy. They are made at the Chester, Pa., plant of American Steel Foundries.

Material Handling Machinery Manufacturers' Association Establishes New York Office

Zenas W. Carter has resigned as commissioner of the Associated Metal Lath Manufacturers to become managing executive secretary of the Material Handling Machinery Manufacturers' Association, which has been formed by companies manufacturing material-handling machinery at the suggestion of the Department of Commerce and the United States Shipping Board. Offices will be established in New York City by March 1 at 35 West Thirty-ninth street.

Admiral Bowles Resigns from Emergency Fleet Corporation

Rear Admiral Francis T. Bowles, assistant general manager of the Emergency Fleet Corporation, has tendered his resignation, to take effect on March 15. The announcement of Admiral Bowles' resignation was made by the Shipping Board on February 3, with the statement that Mr. Bowles probably would retain his connection with the Board in some other capacity.

PERSONAL

E. S. SPAETIG, who has been active in construction work at Hog Island, has been made superintendent of steel construction at the Groton Iron Works, Groton, Conn.

A. M. MAINE, naval architect, has been appointed general superintendent of the Groton Iron Works, Groton, Conn.

ALEX AFANASSIE is now inspector in the ship fitting department of the Submarine Boat Corporation, Newark, N. J.

J. A. RIDLEY, who recently resigned from the McDougal-Duluth Company to become naval architect at the Canadian Car & Foundry Company, Fort William, has accepted a position as hull inspector for the Emergency Fleet Corporation in the Ninth District.

A. MUHLHAUSER has been appointed chairman of the executive committee dealing with the employment problems of the Atlantic Coast Shipbuilders' Association. He is at present employment manager for the Baltimore Dry Docks & Shipbuilding Company, of Baltimore, Md.

WILFRED JESSUP has resigned as acting head of the labor supply division of the Emergency Fleet Corporation. The resignation became effective February 15.

ROBERT N. KING, head of the special dispatch agency of the Shipping Board, has tendered his resignation to return to private business. The agency has served to expedite transportation of cargoes through investigating and remedying delays.

CAPT. FRANK E. FERRIS, of San Francisco, has succeeded Capt. Charles Yates as the managing agent at the New York office of the division of operations of the United States Shipping Board.

CHESTER W. CUTHELL has resigned as general counsel of the United States Shipping Board Emergency Fleet Corporation. In his place, W. H. White, of Norfolk, Va., has been made general counsel.

AT THE ANNUAL MEETING of the Marine Engineers' Beneficial Association, on January 1, William S. Brown was again elected president. The other national officers elected were: First vice-president, J. S. Purdy, of San Francisco; second vice-president, William F. Hyman, of Baltimore, Md.; third vice-president, E. C. Killian, of New Orleans; secretary, George A. Grubb, of Chicago; treasurer, Albert L. Jones, of Detroit; executive committee, R. L. Goelet, representing the Atlantic coast; C. S. Folett, representing Pacific coast; William J. Garrett, the Great Lakes; E. C. Killian, the South Atlantic and Gulf; C. M. Sheplar, Western rivers.

K. H. SCHEEL, who has been actively engaged in the training of hull draftsmen on the Pacific Coast since the entry of the United States into the war, has received public recognition of the value of his work in the honorary resolutions, which were presented to him on January 28 by the men who had taken the course. His instruction has covered ship calculation, design and propulsion.

CAPTAIN HARRY GEORGE, who took command of the Mare Island Navy Yard during the activities of the last year, has again resigned from active service.

J. BRUCE ISMAY has presented £25,000 ($100,000) to the English Mercantile Marine Service Association, as a mark of his appreciation of the work of officers and men during the war.

CAPTAIN WILLIAM D. SOUTHWICK has been appointed supervisor of recruiting stations for the United States Shipping Board, with offices in Boston, the national recruiting service headquarters.

CAPT. JOHN L. ANDERSON, president of the Anderson Shipbuilding Corporation of Lake Washington, has been appointed superintendent of transportation, having jurisdiction over the county's fleet of ferries at Seattle.

RICHARD CONNELL, commander of the concrete ship *Faith*, has been appointed to the command of the big steel steamer *Triumph*, for the Bethlehem Shipbuilding Corporation.

E. E. PALEN, general agent of the Hampton Roads district of the United States Shipping Board, sailed for Europe for the purpose of surveying merchant marine conditions and arranging for the establishment of agencies abroad.

J. D. LOWMAN has resigned his position as assistant director of the Chief of Bureaus of the United States Shipping Board in the Northwest district. D. W. Burchard, his assistant, becomes his successor.

WILLIAM G. COXE, formerly president of the Harlan & Hollingsworth Corporation, Wilmington, Del., is now in charge of operations at the Gloucester City and Wilmington plants of the Pusey & Jones Company, succeeding Finn Hannevig, vice-president and general manager, recently resigned.

OBITUARY

PEMBROKE JONES, vice-president of the Carolina Shipbuilding Corporation, Wilmington, N. C., died on January 24, following an operation.

Wallace H. Roe, president of the Pittsburgh Steel Company, died on February 3. He has been a factor in the steel industry since 1886.

Farewell Luncheon in Honor of Axel Rossell, Assistant Naval Architect of the Emergency Fleet Corporation, Given by His Associates in the Engineering Section on February 8 at the Bellevue-Stratford. Alfred H. Haag, Chief Constructor, Presided, and the Speakers Were H. C. Sadler, Naval Architect; D. H. Cox, Manager Ship Construction Division, and Charles Piez, Director General

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Chairman Hurley's Plan for the Operation of the New American Merchant Marine

THE operation of a fleet of 16,000,000 tons of merchant vessels, 70 percent of which is owned by the Government, is a problem which faces the Government and people of the United States for immediate solution. To-day the Government owns 555 ocean-going steel cargo ships, aggregating 3,385,475 deadweight tons, and, in addition, has under contract 1,336 similar vessels of 9,375,006 deadweight tons. If the present shipbuilding programme is carried out, there will be under the American flag next year 16,732,700 deadweight tons of ocean-going steel cargo and passenger ships, or a fleet equivalent to almost half the merchant tonnage which plies the seas to-day under the flags of all nations combined.

As a solution of this problem, Edward N. Hurley, chairman of the United States Shipping Board, in an address delivered at the annual dinner of the National Marine League in New York on March 27, proposed the following plan:

"The ships should be sold to and operated by American citizens under no restrictions other than the terms of the bill of sale and the fixation of maximum freight rates, either as provided in Section 18 of the Act approved September 7, 1916, or as may be agreed by the Government and the operator in specific instances.

"The ships should be sold at a price which fairly reflects the current world market for similar tonnage.

"Twenty-five percent of the purchase price of each ship should be paid down, the remainder falling due and payable in graded annual instalments over a period not exceeding ten years. The Government should take and hold a mortgage for the unpaid balance, charging interest thereon at the customary commercial rate of five percent. One-fifth of this interest, representing the difference between the customary Government interest of four percent and the customary commercial rate, should be paid into a Merchant Marine Development Fund to be described hereafter.

"The purchaser should be required to agree to insure, and keep insured, with an American marine insurance company his equity in the vessel, and because the American marine insurance market has not at present sufficient resources to underwrite all the vessels the Government has to sell, the Government should carry in its own fund, as at present, but for purchaser's account, hull and machinery insurance covering that part of the vessel for which payment has not been made. Our experience in operation shows that the Government can carry this insurance for at least one percent less than the open market rate. However, it is proposed that the open market rate be charged, and that the difference be paid into the Merchant Marine Development Fund.

"It is understood that no transfer of a vessel to foreign registry should be permitted without express permission of the Government.

"Each purchaser who wishes to operate in the foreign trade should be obliged to incorporate under Federal charter, the necessary legislation for which should be passed by Congress without delay. Such a charter should provide that no stock shall be issued in excess of the money value actually paid in on vessel property, and that no stock can be issued or transferred to an alien.

"It should also provide that one member of the Board of Directors for each company shall be named by the Government. This director should draw no salary, either from the steamship corporation or from the Government. He should receive only the customary director's fee for each meeting he attends.

"The same legislation should provide for periodical meetings of these Government-named directors in the city of Washington, where they will constitute an official body which will confer with and advise the Shipping Board, or other designated Government agency, upon problems arising in, or questions affecting the welfare of, the American merchant marine, including the administration of the Merchant Marine Development Fund.

"This fund, drawn from the sources previously indicated, should be used to relieve such financial difficulties as may be encountered in the development of an adequate and well-balanced American merchant marine. For instance:

"It is foreseen that a number of trade routes important to the immediate or future welfare of American commerce must be established and developed. Some of these routes may not yield steamship operating profits until their existence shall have attracted an increased volume or better balance of trade. Revenue derived from the carriage of mail, and possible fees for the training of seamen and cadet officers, may partly compensate losses incurred on these routes. Still, in cases where the Government sells a ship upon condition that it be operated in a route which may not prove profitable at once, it will be necessary to provide for the payment of defaulted interest from the

Merchant Marine Development Fund, in the discretion of the Shipping Board or other Government agency, upon recommendation of the Board of Government Directors, until such time as the route may begin to yield profit. When the ships in the route earn their annual interest rate and a profit, one-half the profit earned each year should be paid into the Merchant Marine Development Fund until all moneys drawn from the fund on account of the vessel in question shall have been replaced. The other half should go annually to the steamship stockholders.

"Such vessels cruising in routes which fail to prove susceptible of profitable development, and which do not serve any purpose of the Government of the United States, may be transferred by the Government to other routes. However, should the Government become convinced that any vessel has failed to make expenses solely or chiefly because of incapable management, it may foreclose its mortgage on that vessel.

"On the basis of one billion dollars' worth of ships, the Merchant Marine Development Fund would be, for the first year, fourteen million dollars. This amount, investigation convinces me, would be more than sufficient to care for all deficiencies likely to develop during this period.

"Until sold under the terms just stated, all vessels should remain the property of and should be operated by the Government of the United States."

In order to make this plan effective, according to Mr. Hurley, it will be necessary to ask Congress for only three statutes: One, to authorize the incorporation of steamship companies under Federal charter along the lines proposed; another, to extend the Emergency Board to carry hull and machinery insurance in the Shipping Board's fund so that this function may continue to be performed by some designated Government agency so long as the Government may continue to hold an equity in any of the vessels it now owns or has under contract; and a third statute to revise the present status of vessel mortgages so as to make them attractive to bankers and other investors.

Mr. Hurley's plan for the operation, or rather the sale, of the new American merchant marine is remarkable for its failure to take into consideration conditions which are at the bottom of the successful operation of a merchant fleet rather than for the things which he proposes to do. Mr. Hurley states that personally he is opposed to Government ownership, except as a last resort. So is practically everyone else who appreciates the difficulties of operating the merchant marine, but Mr. Hurley admits that our foreign trade and the operation of American ships will decline unless there is a profit for the men who invest their money in this enterprise.

What assurance does Mr. Hurley's plan give to investors that these vessels can be operated profitably? Shipping men and other investors have always had the opportunity of buying vessels at current market prices and engaging in the shipping business subject to the navigation laws of the United States. But past experience has shown that existing laws make the cost of operation of American vessels so high that it is practically impossible for American shipping interests to compete for foreign trade. Mr. Hurley's plan ignores this condition entirely and makes no provision for overcoming the paramount obstacle in the operation of the American merchant marine—that is, the high cost of operation.

The terms under which Mr. Hurley proposes to sell the Government ships to private interests are perhaps as favorable as could be desired, except that many will undoubtedly believe that it would be a wiser policy to extend the time of payment for a longer period—say twenty years instead of ten years, as proposed. It is quite true that the economic importance of this great fleet will be difficult to overestimate and that the future development of our overseas trade and of the domestic industries which feed it will depend more upon the successful operation of the merchant marine under a sound financial and administrative plan than upon any other factor. Mr. Hurley points out that under private ownership the man who enters the shipping business enters a battle against the wits of the world and that his success depends upon something closely akin to genius. It would indeed be a resourceful and skillful ship operator who could accept the burdens imposed by American shipping laws and, with no other assistance than the opportunity to purchase as many vessels as he could afford to buy under current market prices, achieve success in foreign commerce against the world's competition.

An attempt is made in this plan to relieve such financial difficulties as may be encountered in the early stages of development of new steamship lines by means of a Merchant Marine Development Fund, which, on the basis of a billion dollars' worth of ships, it is estimated will amount to about $14,000,000, and which will be administered by the Shipping Board or some other Federal agency. This fund is created by the setting aside of certain moneys representing the difference between the customary commercial charges for interest and insurance and the rates at which the Government in virtue of its peculiar position is enabled to charge. It is assumed that any disbursements which may be made from this fund during the first few years will be returned during the last few years of the ten-year period required for the payment of the vessels. Assuming that the money will be placed in an approved depository where it can draw interest at 2 percent compounded semi-annually, it is estimated that the size of the fund for the ten-year period will amount to over $83,000,000. The assistance which it is proposed to render with this fund is to take the place of Government backing for the development of new trade routes in the national interest. It is pointed out that not one cent of this fund is drawn from the public treasury; instead, the money represents profits foreborne by the Government, which is not entitled to earn profit while engaged in developing the industries of its people.

If, under the conditions which exist, there should be a ready market among American investors for the Government ships, the success of this plan might be assured, but unless some more definite plan is devised for meeting competition in overseas commerce, it seems quite likely that the Government will have some difficulty in disposing of its enormous fleet under the terms proposed. In that case a large part of it will remain under Government ownership, and, as it is inconceivable that this fleet will be kept idle, private owners will find that they may be forced into competition with a not inconsiderable Government-owned and operated merchant fleet—a prospect which cannot be viewed without misgiving.

Mr. Hurley's opposition to Government ownership, his zeal in safeguarding the public from exploitation and his broad conception of the economic value of the merchant marine to the nation and its future welfare and prosperity will meet with universal approval. But, to use his own words, "Our first thought must be of the effect of any inadequate solution upon the 100,000,000 people who compose the United States; their interests must come first."

We have no apprehension of the results if American shipowners can meet their competitors on even terms, but until the inequalities in the cost of building and operating vessels are disposed of, the future of the American merchant marine under private ownership is necessarily uncertain and obscure.

Our Staff of Contributing Editors

In order to increase the usefulness of Marine Engineering to its readers in dealing with the varied problems arising in the present-day development of naval architecture, marine engineering, shipbuilding and ship operation, we take pleasure in announcing as a part of our organization the following staff of contributing editors: Professor C. H. Peabody, head of the department of naval architecture and marine engineering of the Massachusetts Institute of Technology; William Gatewood, naval architect, Newport News Shipbuilding & Dry Dock Company; Rear Admiral C. W. Dyson, U. S. N., head of the designing department of the Bureau of Steam Engineering of the Navy Department; Captain C. A. McAllister, engineer-in-chief of the United States Coast Guard Service; Commander S. M. Robinson, U. S. N., of the Bureau of Steam Engineering; William T. Donnelly, consulting engineer, and H. McL. Harding, consulting marine terminal engineer.

Shipping Board Appropriations, Contracts and Cancellations

In order to set at rest any misapprehensions regarding the resources and future plans of the Emergency Fleet Corporation for shipbuilding, caused by the signing of the armistice and later by the failure of Congress to make the appropriations asked for by the Shipping Board, Marine Engineering has secured from Charles Piez, director-general of the Emergency Fleet Corporation, the following statement outlining the present status of the shipbuilding programme, appropriations available and cancellations so far made:

The net programme of steel cargo, tanker and troopship construction, after deducting deliveries, suspensions and cancellations, is as follows: One thousand and twenty-five cargo ships of 7,016,502 deadweight tons, 81 tankers of 737,320 deadweight tons, and 66 troopships of 655,150 deadweight tons, or a total of 8,408,972 tons yet to be built. Work on wooden ships has been brought almost to a standstill. Cancellations of steel ship construction, beginning with the armistice, cover 156 cargo ships of 1,296,525 deadweight tons, 29 tankers of 268,200 deadweight tons, 35 troopships of 280,000 deadweight tons, 9 requisitioned cargo ships of 97,700 deadweight tons, and 56 ocean-going tugs.

Appropriations for substantially $1,900,000,000 (£390,000,000) have been made for the construction of contract ships, of which on March 1 there was an unspent balance of something over $500,000,000 (£102,500,000), an amount sufficient to carry the work into September, before which time it is hoped the new Congress will have provided additional funds. A total of $515,000,000 (£105,800,000) has also been authorized for requisitioned ships. As the appropriations from this fund so far made, totaling $415,000,000 (£85,300,000), have been practically exhausted, and as the last Congress failed to make additional appropriations asked for, the Emergency Fleet Corporation, under perfectly proper definitions, has transferred some of the vessels on the requisitioned account to the account of the contract ships. The funds provided for plant and housing construction and transportation are sufficient to carry out substantially the programme originally planned. It is apparent, therefore, that the shipyards of the country still have a very formidable programme of construction ahead of them, and that no fear need be entertained of an early cessation of work, if the next Congress will grant the necessary appropriations out of the amounts already authorized.

LETTER TO THE EDITOR

Credit Where Credit Is Due

The London *Engineer* in its issue of February 7, 1919, had the following editorial:

"Unofficial messages indicate that the *Constitution* class will be entirely redesigned, with all propelling machinery and boilers placed well below the waterline, a complete belt of armor, and a main battery of eight 16-inch guns. In other words, the essential features of the latest British battle cruisers are to be incorporated in the new American ships. It need hardly be said that this decision implies a handsome compliment to British naval architects and shipbuilders, whose prestige has never stood higher than it does to-day. Just as the *Majestics* of 1893 became the universally accepted model for battleship construction in every foreign country, so our present-day capital ships, cruisers, and even torpedo craft, are being duplicated more or less faithfully by all the leading naval powers. It is, perhaps, the finest tribute of all that the United States, which has hitherto endeavored to plan its fighting ships on original lines, should now be on the point of rejecting a purely American design in favor of one embodying what we are entitled to regard as typically British characteristics."

Whether the comments made by the editor of *The Engineer* are justified or not with relation to the battle cruisers recently designed for the United States Navy, I must take exception to the general remark that hitherto the United States has endeavored to plan its fighting ships on original lines and now is rejecting a purely American design in favor of a typically British design.

In the first place, the word "endeavored" has been used with a peculiarly unhappy inference; as much as to say that all endeavors of the United States Navy, where they departed from British practice, were failures.

Referring to the history of the design of war vessels, it may be well to point out to our English critic that the British battleship design has its foundation in the experience gained with the *Monitor* and *Merrimack* during the war of the rebellion in the 60's. Neither of these designs was British in any sense.

It would appear, therefore, that we must go back to designs worked out in the United States to find the prototype of the present British battleship. Coming down to more recent times and to one of the "endeavors" of the United States Navy, I would point out that when the present system of mounting heavy guns in turrets, one firing over the other, on the center line of the vessel was brought out by the United States, the British Admiralty criticised this disposition in the severest terms. At the present time, however, there is no navy in the world, including the British, but what has its major guns mounted in the American style. The British Navy, indeed, has gone so far as to adopt this inherent principle, in the mounting of the guns, on its latest torpedo-boat destroyers.

Another "endeavor" which I would refer to is that the present destroyers of the British Navy, in so far as the raised forecastle is concerned, is a direct take-over from the destroyers of the United States Navy built between the years of 1898 and 1915.

While willingly assenting to the great research and progress made in the design of war vessels by the British, and the large amount of pioneer work done by them, nevertheless our own modest contributions to the art of warship design should not be so summarily dismissed.

William A. Dobson, Naval Architect,
Wm. Cramp & Sons Ship & Engine Building Co.

Shipping Board Contracts for Ships

Complete List of Vessels Contracted for or Requisitioned by the Shipping Board Up to January 31, 1919

STEEL SHIPS CONTRACTED, REQUISITIONED AND CONTRACTS PENDING

Company	Type	D. W. T. Per Ship	Contracted For, Requisitioned and Contracts Pending No.	Tons	Delivered No.	Tons	Being Fitted Out in Wet Basin No.	Tons	On Ways No.	Tons	Balance on Contracts No.	Tons
Recapitulation by Districts....												
North Atlantic	Cargo		287	1,920,730	34	262,825	34	221,900	74	540,798	145	895,207
Delaware River	"		159	1,357,502	54	399,257	14	106,300	34	308,995	57	542,950
Delaware River Agencies	"		240	1,925,000	4	30,000	14	111,000	61	480,500	161	1,303,500
Middle Atlantic	"		113	1,053,560	29	235,960	4	34,800	21	198,900	59	583,900
Southern	"		86	623,300	..	......	2	7,000	22	169,300	62	447,000
Southern Pacific	"		235	2,147,000	53	495,000	27	249,150	46	416,050	109	986,800
Northern Pacific	"		307	2,609,994	110	910,394	21	171,600	45	387,400	131	1,140,600
Great Lakes	"		445	1,683,250	190	657,750	41	160,550	73	293,000	141	571,950
Country	"		1,872	13,320,336	474	2,991,186	157	1,062,300	376	2,794,943	865	6,471,907
Japan	"		45	374,670	15	128,820					30	245,850
China	"		4	40,000							4	40,000
Total			1 921	13,735,006	489	3,120,006	157	1,062,300	376	2,794,943	899	6,757,757
Tugs			112	A		....	9	....	28	....	75	A
Barges			10	31,000		....		....	1	7,500	9	23,500
Grand Total			2,043	13,766,006	489	3,120,006	166	1,062,300	405	2,802,443	983	6,781,257
Resume of All Steel Ships by Tonnage Classification...												
Under 5,000 D. W. Tons	Cargo		510	1,938,322	225	792,922	48	186,600	82	329,800	155	629,100
5,000 to 5,999 D. W. Tons	"		215	1,095,625	9	47,900	25	127,500	39	198,250	142	721,975
6,000 to 7,499 D. W. Tons	"		84	573,980	39	266,400	5	36,500	16	108,398	24	162,682
7,500 to 8,500 D. W. Tons	"		271	2,079,790	27	207,990	20	152,000	65	493,500	159	1,226,300
8,501 to 9,999 D. W. Tons	"		657	5 977 856	144	1,287,536	48	437,900	139	1,274,620	326	2,977,800
10,000 and over D. W. Tons	"		184	2,069,433	45	517,258	11	121,900	35	390,375	93	1,039,900
Total			1,921	13,735,006	489	3,120,006	157	1,062,300	376	2,794,943	899	6,757,757
Tugs no D. W. Tons			112	A			9	A	28	A	75	A
Barges 2,000 D. W. Tons			8	16,000							8	16,000
Barges 7,500 D. W. Tons			2	15,000					1	7,500	1	7,500
Total			122	31,000			9	A	29	7,500	84	23,500
Grand Total			2,043	13,766,006	489	3,120,006	166	1,062,300	405	2,802,443	983	6,781,257

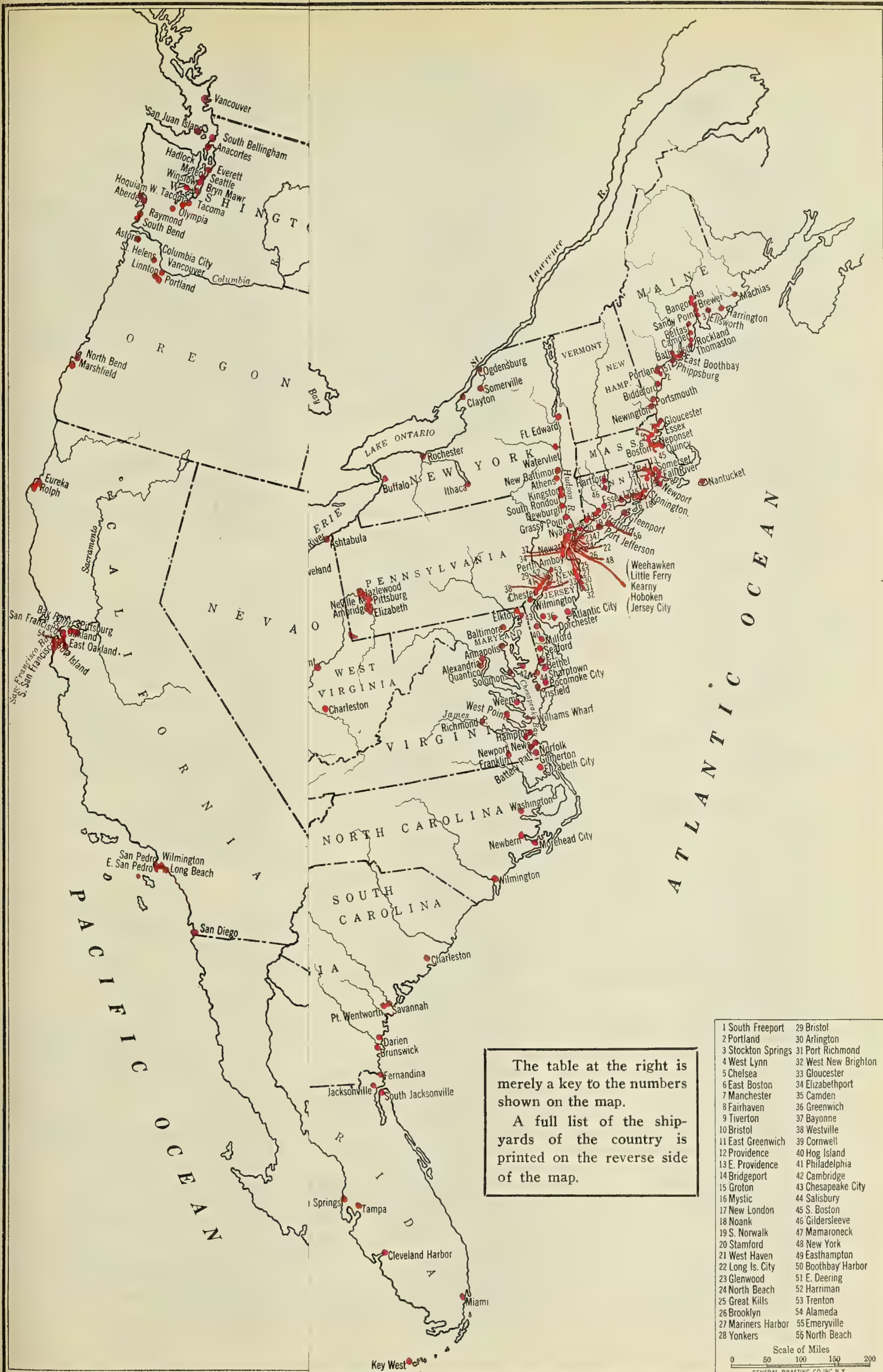
A—Tug Boats no tonnage given.

STEEL TUGS CONTRACTED FOR AND CONTRACTS PENDING

District	Type	D. W. T. Per Ship	Contracted For and Contracts Pending No.	Tons	Delivered No.	Tons	Being Fitted Out in Wet Basin No.	Tons	On Ways No.	Tons	Balance on Contracts No.	Tons
North Atlantic	Ocean		66	A			6	A	15	A	45	A
Southern	Harbor		6	A					4	A	2	A
Great Lakes			40	A			3	A	9	A	28	A
Country	Ocean Harbor		104 8	A A			9	A	24 4	A A	71 4	A A
Grand Total			112	A			9	A	28	A	75	A
Steel Barges Contracted for and Contracts Pending Southern			10	31,000					1	7,500	9	23,500
Concrete Ships Contract'd For North Atlantic	Cargo	3,500	1	3,500					1	3,500		
Middle Atlantic	Cargo	3,500	2	7,000					2	7,000		
Southern			6	40,500			1	3,000	4	30,000	1	7,500
Southern Pacific	Tanker		5	37,500					4	30,000	1	7,500
Grand Total			14	88,500			1	3,000	11	70,500	2	15,000

COMPOSITE SHIPS CONTRACTED FOR

District	Type	Design		Contracted For Total No. Ships	Total Tonnage	Delivered No.	Tons	Being Fitted Out in Wet Basin No.	Tons	On Ways No.	Tons	Balance on Contracts No.	Tons
Southern	Cargo	McClelland	3,500	24	84,000	6	21,000	7	24,500	11	38,500		
District No. 11	Cargo	Ball n	4 000	8	32,000	5	20,000	3	12,000				
Grand Total				32	116,000	11	41,000	10	36,500	11	38,500		



The table at the right is merely a key to the numbers shown on the map.

A full list of the shipyards of the country is printed on the reverse side of the map.

1	South Freeport	29	Bristol
2	Portland	30	Arlington
3	Stockton Springs	31	Port Richmond
4	West Lynn	32	West New Brighton
5	Chelsea	33	Gloucester
6	East Boston	34	Elizabethport
7	Manchester	35	Camden
8	Fairhaven	36	Greenwich
9	Tiverton	37	Bayonne
10	Bristol	38	Westville
11	East Greenwich	39	Cornwell
12	Providence	40	Hog Island
13	E. Providence	41	Philadelphia
14	Bridgeport	42	Cambridge
15	Groton	43	Chesapeake City
16	Mystic	44	Salisbury
17	New London	45	S. Boston
18	Noank	46	Gildersleeve
19	S. Norwalk	47	Mamaroneck
20	Stamford	48	New York
21	West Haven	49	Easthampton
22	Long Is. City	50	Boothbay Harbor
23	Glenwood	51	E. Deering
24	North Beach	52	Harriman
25	Great Kills	53	Trenton
26	Brooklyn	54	Alameda
27	Mariners Harbor	55	Emeryville
28	Yonkers	56	North Beach

The table at the right is merely a key to the numbers shown on the map.

A full list of the shipyards of the country is printed on the reverse side of the map.

1 South Freeport	29 Bristol
2 Portland	30 Arlington
3 Stockton Springs	31 Port Richmond
4 West Lynn	32 West New Brighton
5 Chelsea	33 Gloucester
6 East Boston	34 Elizabethport
7 Manchester	35 Camden
8 Fairhaven	36 Greenwich
9 Tiverton	37 Bayonne
10 Bristol	38 Westville
11 East Greenwich	39 Cornwell
12 Providence	40 Hog Island
13 E. Providence	41 Philadelphia
14 Bridgeport	42 Cambridge
15 Groton	43 Chesapeake City
16 Mystic	44 Salisbury
17 New London	45 S. Boston
18 Noank	46 Gildersleeve
19 S. Norwalk	47 Mamaroneck
20 Stamford	48 New York
21 West Haven	49 Easthampton
22 Long Is. City	50 Boothbay Harbor
23 Glenwood	51 E. Deering
24 North Beach	52 Harriman
25 Great Kills	53 Trenton
26 Brooklyn	54 Alameda
27 Mariners Harbor	55 Emeryville
28 Yonkers	56 North Beach

Scale of Miles
0 50 100 150 200

GENERAL DRAFTING CO INC N Y

ATLANTIC COAST

Maine

BANGOR
Bangor Shipbuilding Corporation.
BATH
Bath Iron Works, Ltd.
Crosby Navigation Co.
G. G. Deering Co.
Kelley-Spear Co.
Percy & Small, Inc.
The Texas Steamship Co.
BELFAST
Mathews Brothers.
BIDDEFORD
Biddeford Shipbuilding Co.
BOOTHBAY HARBOR
The Atlantic Coast Co.
East Coast Ship Co.
BREWER
Bangor-Brewer Shipbuilding Co.
CAMDEN
R. L. Bean.
Camden Anchor—Rockland Machine Co.
Camden Yacht Building and Railway Co.
EAST BOOTHBAY
F. C. Adam.
Hodgdon Brothers.
Rice Brothers Co.
ELLSWORTH
Ellsworth Foundry & Machine Works.
HARRINGTON
Frye Flynn Company.
MACHIAS
Machias Ship Construction Company.
PHIPPSBURG
Bowker Ship Yard.
PORTLAND
Cumberland Shipbuilding Co.
Portland Ship Ceiling Company.
Russell Shipbuilding Co.
ROCKLAND
Francis Cobb Shipbuilding Company.
Rockland & Rockport Lime Co.
SANDY POINT
Sandy Point Shipbuilding Corp.
SOUTH FREEPORT
Freeport Shipbuilding Co.
SOUTH PORTLAND
Portland Shipbuilding Co.
STOCKTON SPRINGS
Stockton Yards, Inc.
THOMASTON
Atlantic Coast Co.
Dunn & Elliot Co.
George A. Gilchrest.

New Hampshire

PORTSMOUTH
The Atlantic Corporation.

Massachusetts

CHELSEA
Richard T. Green Co.
EAST BOSTON
Atlantic Works.
Bertelson & Peterson.
S. W. K. Brooks.
Simpson's Patent Dry Dock Co.
ESSEX
John F. James & Son.
Story's Ship Yard.
FAIRHAVEN
New Bedford Dry Dock Co.
GLOUCESTER
Burnham Brothers Marine Railways Co.
The Rocky Neck Marine Railway Company.
MANCHESTER
W. B. Calderwood.
NANTUCKET
Nantucket Shipbuilding Company.
NEPONSET
Geo. Lawley & Son Corp.
QUINCY
Baker Yacht Basin, Inc.
Bethlehem Shipbuilding Corp.
SOUTH BOSTON
Murray & Tregurtha Co.
SOUTH SOMERSET
Crowninshield Shipbuilding Co.
WEST LYNN
Coastwise Ship Engineering Co.

Rhode Island

BRISTOL
Herreshoff Mfg. Co., Inc.
EAST GREENWICH
Frederic S. Nock.
NEWPORT
Newport Ship Yard.
PROVIDENCE
Aberthaw Construction Co.
Providence Dry Dock & Marine Railway Co.
Providence Engineering Corp.
TIVERTON
Narragansett Ship Building Co.

Connecticut

BRIDGEPORT
The Lake Torpedo Boat Company.
ESSEX
Dauntless Shipyard, Incorporated.
GILDERSLEEVE
The Gildersleeve Ship Construction Co.
GROTON
Groton Iron Works (Groton Plant).
HARTFORD
The Hartford & New York Transportation Co.
MYSTIC
Mystic Marine Ry. Co.
NEWINGTON
L. H. Shattuck, Inc., Shipyard.
NEW LONDON
Thames Tow Boat Co.
NOANK
Groton Iron Works (Noank Plant).
SOUTH NORWALK
Miller's Boat Yard.
STAMFORD
Luders Marine Construction Company.
STONINGTON
Ship Construction & Trading Co., Inc.
STRATFORD
The Housatonic Shipbuilding Co.
WEST HAVEN
The Connecticut Ship & Construction Corp.
The New Haven Shipyard, Inc.
WEST MYSTIC
Wood & McClure.

New York

ATHENS
Athens Shipbuilding Corporation.
Louis B. Harrison Shipyards, Inc.
BROOKLYN
Ira S. Bushey & Sons, Inc.
Theodore Crane's Sons.
Furman Dry Dock Co.
A. Hansen.
Hunters Point Dry Dock.
Jakobson & Peterson.
Morse Dry Dock & Repair Co.
Robins Dry Dock & Repair Co.
Schuyler & Caddell.
Jas. Shewan & Sons, Inc.
Tebo Yacht & Basin Co.
Ward & Co.
GLENWOOD LANDING
Fyfe's Shipyard.
GRASSY POINT
Sutherland & Sons.
GREAT KILLS
Great Kills Boat Works.
GREENPORT
Eastern Shipyard Co., Inc.
Greenport Basin & Construction Co.
Greenport Ship Co., Inc.
Sterling Ship Yard & Machine Works.
HUDSON FALLS
"Fort Edward" Yard.
ITHACA
Cummings Structural Concrete Co.
KINGSTON
Kingston Shipbuilding Corp.
Jacob Rice & Sons.
LONG ISLAND
Fougner Concrete Shipbuilding Co., Inc.
LONG ISLAND CITY
Astoria Boat Works & Marine Equipment Co., Inc.
The Terry & Tench Co.
MAMARONECK
Sound Machine Shop, Inc.
MARINER'S HARBOR
Brewer Dry Dock Company.
Johnson Shipyards Corporation.
Staten Island Shipbuilding Co.
NEW BALTIMORE
Wm. H. Baldwin.
NEWBURGH
Newburgh Shipyards, Inc.
Tank-Ship Building Corp.
NEW YORK CITY
Cast Steel Ship Corporation.
Dawn Boat & Shipbuilding Corp.
Downey Shipbuilding Corp.
Gas Engine & Power Co. and Chas. L. Seabury & Co., Consolidated.
Great Kills Shipyard & Repair Co.
Robert Jacob Shipyard.
Kyle & Purdy, Inc.
McAllister Dry Dock & Shipyard Co.
Frank McWilliams, Inc.
Henry B. Nevins.
New Jersey Shipbuilding & Dredging Co.
New York Yacht, Launch & Engine Co.
Standard Shipbuilding Corp.
James Tregarthen & Sons Co., Inc.
NYACK
International Shipbuilding and Marine Engineering Corp.
Julius Petersen.
PORT JEFFERSON
Bayles Shipyard, Inc.
PORT RICHMOND
Alexander McDonald, Incorporated.
SOUTH RONDOUT
C. Hiltebrant Dry Dock Co.
WATERVLIET
P. Jesse Matton.
WEST NEW BRIGHTON
National Dry Dock & Repair Co., Inc.
YONKERS
Continental Shipbuilding Corp.

New Jersey

ATLANTIC CITY
Atlantic City Steamship & Terminal Co.
BAYONNE
The Elco Works.
Port Johnston Dry Dock Co.
CAMDEN
Camden Shipbuilding Co.
Dempsey & Sons.
Mathis Shipbuilding Co.
New York Shipbuilding Corporation.
Noecker & Ake Shipbuilding Co.
DORCHESTER
Shaw & Champion.
ELIZABETHPORT
Bethlehem Shipbld. Corp. (Moore Plant.
New Jersey Dry Dock & Transportation Co.
GLOUCESTER CITY
Pusey & Jones Company.
GREENWICH
Greenwich Piers Marine Railway Co.
HOBOKEN
W. & A. Fletcher Co.
Tietjen & Lang Dry Dock Co.
JERSEY CITY
Brown Dry Dock Co.
Barge & Lighter Repair Co., Inc.
Liberty Dry Dock & Repair Co.
Vulcan Iron Works, Inc.
KEARNEY
Federal Shipbuilding Co.
LITTLE FERRY
Ambursen Construction Company, Inc.
NEWARK
Submarine Boat Corp.
PERTH AMBOY
Perth Amboy Dry Dock Co.
WEEHAWKEN
Union Dry Dock & Repair Co.
WESTVILLE
Westville Boat Building Co.

Pennsylvania

BETHLEHEM
Bethlehem Shipbuilding Corporation, Ltd.
BRISTOL
Merchant Shipbuilding Corp.
CHESTER
Chester Shipbuilding Company, Ltd.
Sun Shipbuilding Company.
CORNWELLS HEIGHTS
Traylor Shipbuilding Corp.
HARRIMAN
Merchant Shipbuilding Corporation.
HOG ISLAND
American International Shipbuilding Corp.
PHILADELPHIA
The William Cramp & Sons Ship & Engine Building Company.
Kensington Shipyard Dept. of Wm. Cramp & Sons. S. & E. B. Co.
The Philadelphia Ship Repair Company.
Southern Ship Building Company.

Delaware

BETHEL
Smith & Terry, Inc.
MILFORD
William G. Abbott Shipbuilding Co.
Vinyard Ship Building Co.
SEAFORD
Delaware Ship Building Co.
WILMINGTON
American Car & Foundry Co., Jackson & Sharp Plant.
Bethlehem Shipbuilding Corporation, Ltd., Harlan Plant.
The Pusey & Jones Co.

Maryland

ANNAPOLIS
The Chance Marine Construction Co.
BALTIMORE
The Baltimore Dry Docks & Ship Building Co.
Booz Brothers.
Chesapeake Marine Railway Co.
Coastwise Shipbuilding Co.
H. E. Crook Co., Inc.
McIntyre & Henderson.
Marine Engine & Boiler Co.
The Maryland Ship Building Co.
Nilson Yacht Building Co.
Redman-Vane Shipbuilding Co.
Chas. L. Rhode & Sons Co.
Henry Smith & Sons Co.
The Spedden Shipbuilding Co.
Union Shipbuilding Co.
Wm. E. Woodall & Co.
CAMBRIDGE
The Cambridge Mfg. Co.
Geo. T. Johnson & Sons.
CHESAPEAKE CITY
Southern Transportation Co., Shipyard Dept.
CRISFIELD
Crisfield Marine Railways.
ELKTON
E. Deibert & Co.
FAIRFIELD
Arundel Shipbuilding Co.
POCOMOKE CITY
E. James Tull.
SALISBURY
Wm. W. Smith.
Smith & Williams Co.
SOLOMONS
M. M. Davis & Son, Inc.
SPARROWS POINT
Bethlehem Shipbuilding Corp., Ltd., Maryland Shipbuilding Plant.

Virginia

ALEXANDRIA
Virginia Shipbuilding Corporation.
BATTERY PARK
Bloxom Bros. Corp.
FRANKLIN
The Sharpley Marine Railways.
HAMPTON
Hampton Shipbuilding & Dry Dock Corp.
Newcomb Lifeboat Co., Inc.
NEWPORT NEWS
Newport News Shipbuilding and Dry Dock Co.
NORFOLK
Colonna Marine Railway Corporation.
National Concrete Boat Co., Inc.
Norfolk Marine Railway Co., Inc.
Old Dominion Marine Railway Corp.
G. T. Taylor Marine Railway Corp.
W. E. Thomas & Co.
PORT RICHMOND
York River Shipbuilding Corp.
QUANTICO
Mo. Valley Bridge & Iron Co.
WEEMS
Humphreys Railway & Lumber Corp.
WEST POINT
C. H. Dunnmead & Son.
WILLIAMS WHARF
B. Williams & Co. & Matthews Marine Ry.

North Carolina

ELIZABETH CITY
Elizabeth City Ship Yard Co.
Maritime Engineering Corporation.
MOREHEAD CITY
North Carolina Ship Building Co.
Willis Marine Railways.
WASHINGTON
Beaufort County Iron Works, Inc.
WILMINGTON
Carolina Ship Building Corporation.
Liberty Shipbuilding Company.
Naul Shipbuilding Co.
Wilmington Iron Works—Wilmington Marine Railway Co.

South Carolina

CHARLESTON
Valk & Murdoch Co.

Georgia

BRUNSWICK
American Shipbuilding Company.
Brunswick Marine Construction Corps.
Brunswick Shipbuilding Co.
Oscar Daniels Company.
The Foundation Co.
United States Maritime Corporation.
DARIEN
Darien Shipbuilding Co.
SAVANNAH
Concrete Steel Ship Building Co.
The Foundation Co.
Georgia Shipbuilding Co.
Kehoe's Iron Works.
National Shipbuilding & Dry Dock Co.
Southland Steamship Co. (Shipbuilding Dept.)
Terry Shipbuilding Corporation.
Wilkinson Machine Co.

Florida

CARRABELLE
Dempsey-Camp Shipbuilding Co.
CLEVELAND
Cleveland Steam Marine Railroad.
JACKSONVILLE
Baxter Shipyard, Inc.
The A. Bentley & Sons Co.
Jacksonville Dry Dock & Repair Co.
Merrill-Stevens Co.
Morey & Thomas.
J. M. Murdock.
U. S. Shipping Board, Emergency Fleet Corp.
KEY WEST
William Curry's Sons Co.
MIAMI
Capt. Geo. J. Pilkington, Covered Storage Basin & Boat Builder.
MILLVILLE
American Lumber Co.
Gulf Shipbuilding Co.
MILTON
Bagdad Shipbuilding Co.
PENSACOLA
F. F. Bingham.
The Bruce Dry Dock Company.
Pensacola Shipbuilding Company.
Pensacola Vessel Construction Corporation.
The Warren Fish Co.
SOUTH JACKSONVILLE
St. John's River Shipyard Company.
TAMPA
Oscar Daniels Company.
Hillsboro Shipbuilding Co.
Tampa Dock Co.
Tampa Shipbuilding & Engineering Co.
TARPON SPRINGS
Anclote Shipbuilding Co.
E. Macrenaris Shipbuilding Corporation.

Alabama

MOBILE
Alabama Dry Dock & Shipbuilding Co.
Barret Shipbuilding Co.
Chickasaw Shipbuilding Co.
Concrete Shipyard, Emergency Fleet Corp., Fred T. Ley & Co., Inc.
Henderson Shipbuilding Co., Inc.
Mobile Shipbuilding Company.
Murnan Shipbuilding Corp.
Shell Bank Shipbuilding Co., Inc.

Mississippi

BILOXI
Mississippi Shipbuilding Corp.
GULFPORT
Gulfport Ship Building Company.
MOSS POINT
Dantzler Ship Building & Dry Docks Co.
Hodge Ship Company, Inc.
PASCAGOULA
Dierks-Blodgett Shipbuilding Co.
Gulf Ship Company.
International Ship Building Company.

Louisiana

MADISONVILLE
Jahncke Shipbuilding Corp.
MORGAN
Union Bridge & Const. Co.
NEW ORLEANS
Alabama & New Orleans Transportation Co.
Doullut & Williams Shipbuilding Co., Inc.
The Foundation Co.
Garland Yard of International Navigation Corp.
Jahncke Shipbuilding Corporation.
The Johnson Iron Works, Ltd.
Louisiana Shipbuilding Corp.
New Orleans Dry Dock & Ship Bldg. Co.
Star Ship Yards.
SLIDELL
Louisiana Shipbuilding Corp.
WESTLAKE
Clooney Construction & Towing Co.

Texas

ARANSAS PASS
Macdonald Engineering Co.
BEAUMONT
Beaumont Ship Building & Dry Dock Co.
Lone Star Shipbuilding Co.
McBride & Law, General Contractors.
J. N. McCammon.
GALVESTON
J. L. Bludworth.
Galveston Dry Dock and Construction Co.
Mo. Valley Bridge & Iron Co.
Seaboard Transportation & Shipping Co.
HOUSTON
The Direct Navigation Company.
Houston Ship Building Co.
Midland Bridge Co.
Universal Shipbuilding Company, Inc.
ORANGE
International Ship Building Corp.
National Ship Building Co. (Subsidiary of The Nat'l Oil Co.)
Southern Dry Dock & Ship Building Co.
ROCKPORT
Heldenfels Brothers.

MISSISSIPPI VALLEY

CHARLESTON, W. VA.
The Charles Ward Engineering Works.
DUBUQUE, IOWA
Dubuque Boat & Boiler Works.
GRAFTON, ILL.
Rippley Boat Co.
PADUCAH, KY.
Howard Shipyards & Dock Co.
PITTSBURGH, PA.
American Bridge Co.
The Dravo Contracting Company, Engineering Works Dept.
Elizabeth Marine Ways.
Hazelwood Dock Co.
Pittsburgh Coal Co.
James Rees & Sons Co.
POINT PLEASANT, W. VA.
Enterprise Marine Dock Co.
Kanawha Dock Co.
Point Pleasant Dry Dock Co.
QUINCY, ILL.
Quincy Marine Ways.

GREAT LAKES

ASHTABULA, OHIO
Great Lakes Engineering Works.
BAY CITY, MICH.
James Davidson.
BENTON HARBOR, MICH.
Dachel-Carter Shipbuilding Co.
BUFFALO, N. Y.
Buffalo Dry Dock Co.
Buffalo Marine Construction Corporation.
Ferguson Steel & Iron Co.
The Lake Shipbuilding Co.
CHICAGO, ILL.
Chicago Shipbuilding Co.
Kraft Ship Yard & Dry Dock Co.
CLAYTON, N. Y.
Clayton Ship & Boat Building Corporation.
L. E. Fry & Co., Inc.
CLEVELAND, OHIO
Ohio Shipbuilding Co.
The American Ship Building Co.
The Great Lakes Towing Co.
DETROIT, MICH.
Detroit Shipbuilding Co.
Great Lakes Engineering Works.
Imperial Shipbuilding Corp'n.
DULUTH, MINN.
McDougall-Duluth Company.
Marine Iron & Shipbuilding Company.
ECORSE, MICH.
Great Lakes Engineering Works.
FERRYSBURG, MICH.
Johnston Bros.
GREEN BAY, WIS.
Northwest Engineering Works.
P. F. Thrall.
KEWAUNEE, WIS.
Wisconsin Shipbuilding & Navigation Corp.
LEVANNA, OHIO
Barrett Mill & Lumber Co.
LORAIN, OHIO
American Shipbuilding Co.
LUDINGTON, MICH.
Lunde Boat Bldg. Co.
MANISTEE, MICH.
Manistee Ship Bldg. Co.
MANITOWOC, WIS.
Burger Boat Company.
Manitowoc Shipbuilding Co.
MARINE CITY
Kenyon's Shipyard Company.
Sydney C. McLouth.
MILWAUKEE, WIS.
Fabricated Ship Corporation.
Great Lakes Boat Building Corporation.
Milwaukee Dry Dock Co.
MONTAGUE, MICH.
The Montague Iron Works.
MUSKEGON, MICH.
Peninsula Shipbuilding Corporation.
OGDENSBURG, N. Y.
The St. Lawrence Marine Railway.
OSWEGO, N. Y.
The Foundation Co.
J. H. & T. C. Goble.
PORT CLINTON, OHIO
The Matthews Company.
PORT HURON, MICH.
The Foundation Company.
Wolverine Dry Dock.
RACINE, WIS.
Racine Boat Company.
ROCHESTER, N. Y.
Rochester Boat Works, Inc.
ROCKY RIVER, OHIO.
The Rocky River Dry Dock Company.
SAULT STE. MARIE, MICH.
Heckler Bros.
SAGINAW, MICH.
Saginaw Shipbuilding Company.
STURGEON BAY, WIS.
Leatham & Smith Towing & Wrecking Co.
Universal Shipping Co.
SUPERIOR, WIS.
Globe Shipbuilding Company.
Superior Shipbuilding Co.
Whitney Brothers Company.
TOLEDO
The Toledo Shipbuilding Co.
WASHBURN, WIS.
Anchor Shipbuilding Co.
WEST DULUTH, MINN.
Marine Iron & Shipbuilding Works.

PACIFIC COAST

Alaska

JUNEAU
Alaska Dry Dock & Mfg. Co.

Washington

ABERDEEN
Gray's Harbor Motorship Corporation.
ANACORTES
Sloan Shipyard Corporation.
EVERETT
Pacific Coast Shipbuilding Co.
HADLOCK
Hadlock Shipbuilding Co.
HOUGHTON
Anderson Shipbuilding Corporation.
HOQUIAM
Matthews Shipbuilding Co.
OLYMPIA
Sloan Shipyards Corp.
RAYMOND
Sanderson & Porter.
SEATTLE
Allen Shipbuilding Company.
Ames Shipbuilding & Dry Dock Company.
J. F. Duthie & Co.
Elliott Bay Shipbuilding Co.
Inter-Ocean Barge & Transport Company.
McAteer Ship Bldg. Co.
Maritime Boat and Engine Works, Inc.
Meacham & Babcock Shipbuilding Co.
National Shipbuilding Co.
National Steel Construction Co.
Nilson & Kelez Shipbuilding Corporation.
Paterson-MacDonald Shipbuilding Co.
J. H. Price Shipbuilding Company.
Puget Sound Bridge & Dredging Co.
Seattle North Pacific Shipbuilding Co.
Skinner & Eddy Corporation.
Tregoning Boat Company.
West Waterway Boat Building Company.
Wilson Shipyards.
SOUTH BELLINGHAM
Pacific American Fisheries.
SOUTH BEND
South Bend Shipyard Co., Inc.
TACOMA
American Concrete Pipe & Shipbuilding Company.
The Foundation Co.
Seaborn Shipyards Company.
Tacoma Ship Building Co.
Todd Dry Dock and Construction Corp.
Wright Ship Yards.
VANCOUVER
Motorship Construction Co.
G. M. Standifer Construction Corp.
WINSLOW, WASH.
D. W. Hartzell, Inc.

Oregon

ASTORIA
McEachern Ship Co.
Geo. F. Rodgers & Company.
Wilson Shipbuilding Company.
COLUMBIA CITY
Sommarstrom Shipbuilding Co.
MARSHFIELD
Coos Bay Shipbuilding Company.
NORTH BEND
Kruse & Banks Shipbuilding Company.
NORTH PORTLAND
G. M. Standifer Construction Corp.
PORTLAND
Albina Engine & Machine Works, Inc.
Coast Ship Building Co.
Columbia Engineering Works.
Columbia River Ship Building Corp.
Grant Smith-Porter Ship Company.
The Foundation Co.
Kiernan & Kern.
Northwest Steel Co.
Peninsula Shipbuilding Company.
Supple-Ballin Shipbuilding Corp.
Willamette Shipbuilding Co.
ST. HELENS
St. Helens Shipbuilding Co.

California

BAY POINT, CONTRA COSTA COUNTY
Pacific Coast Shipbuilding Co.
BENICIA
Benicia Shipbuilding Corp.
EAST OAKLAND
Hanlon Dry Dock & Shipbuilding Co., Inc.
EUREKA
Hammond Lumber Company.
LONG BEACH
Long Beach Shipbuilding Co.
OAKLAND
Apex Manufacturing Co., Oakland, Emeryville, Cal.
Hanlon Dry Dock & Shipbuilding Co.
Moore Shipbuilding Company.
San Francisco Ship Building Co.
Union Construction Co.
PITTSBURGH
B. P. Lanteri.
SAN DIEGO
Pacific Marine and Construction Company.
San Diego Marine Construction Co.
San Diego Shipbuilding & Dry Dock Co.
SAN FRANCISCO
C. L. Arques.
Bowes & Andrews (Ship Repairing).
Main Iron Works.
Pacific Coast Shipbuilding Company.
Rolph Shipbuilding Company.
Union Iron Works Co.
Western Pipe & Steel Co. of California.
SAN PEDRO
Los Angeles Shipbuilding & Dry Dock Co.
Southwestern Shipbuilding Company.
SO. SAN FRANCISCO
Schaw Batcher Shipbuilding Co.
WILMINGTON
R. J. Chandler Shipbuilding Co.
Fulton Shipbuilding Company.
West Coast Shipbuilding Co.

MILTON
- Bagdad Shipbuilding Co.

PENSACOLA.
- F. F. Bingham.
- The Bruce Dry Dock Company.
- Pensacola Shipbuilding Company.
- Pensacola Vessel Construction Corporation.
- The Warren Fish Co.

SOUTH JACKSONVILLE
- St. John's River Shipyard Company.

TAMPA
- Oscar Daniels Company.
- Hillsboro Shipbuilding Co.
- Tampa Dock Co.
- Tampa Shipbuilding & Engineering Co.

TARPON SPRINGS
- Anclote Shipbuilding Co.
- E. Macrenaris Shipbuilding Corporation.

Alabama

MOBILE
- Alabama Dry Dock & Shipbuilding Co.
- Barret Shipbuilding Co.
- Chickasaw Shipbuilding Co.
- Concrete Shipyard, Emergency Fleet Corp., Fred T. Ley & Co., Inc.
- Henderson Shipbuilding Co., Inc.
- Mobile Shipbuilding Company.
- Murnan Shipbuilding Corp.
- Shell Bank Shipbuilding Co., Inc.

Mississippi

BILOXI
- Mississippi Shipbuilding Corp.

GULFPORT
- Gulfport Ship Building Company.

MOSS POINT
- Dantzler Ship Building & Dry Docks Co.
- Hodge Ship Company, Inc.

PASCAGOULA
- Dierks-Blodgett Shipbuilding Co.
- Gulf Ship Company.
- International Ship Building Company.

Louisiana

MADISONVILLE
- Jahncke Shipbuilding Corp.

MORGAN
- Union Bridge & Const. Co.

NEW ORLEANS
- Alabama & New Orleans Transportation Co.
- Doullut & Williams Shipbuilding Co., Inc.
- The Foundation Co.
- Garland Yard of International Navigation Corp.
- Jahncke Shipbuilding Corporation.
- The Johnson Iron Works, Ltd.
- Louisiana Shipbuilding Corp.
- New Orleans Dry Dock & Ship Bldg. Co.
- Star Ship Yards.

SLIDELL
- Louisiana Shipbuilding Corp.

WESTLAKE
- Clooney Construction & Towing Co.

Texas

ARANSAS PASS
- Macdonald Engineering Co.

BEAUMONT
- Beaumont Ship Building & Dry Dock Co.
- Lone Star Shipbuilding Co.
- McBride & Law, General Contractors.
- J. N. McCammon.

GALVESTON
- J. L. Bludworth.
- Galveston Dry Dock and Construction Co.
- Mo. Valley Bridge & Iron Co.
- Seaboard Transportation & Shipping Co.

HOUSTON
- The Direct Navigation Company.
- Houston Ship Building Co.
- Midland Bridge Co.
- Universal Shipbuilding Company, Inc.

ORANGE
- International Ship Building Corp.
- National Ship Building Co. (Subsidiary of The Nat'l Oil Co.)
- Southern Dry Dock & Ship Building Co.

ROCKPORT
- Heldenfels Brothers.

MISSISSIPPI VALLEY

CHARLESTON, W. VA.
- The Charles Ward Engineering Works.

DUBUQUE, IOWA
- Dubuque Boat & Boiler Works.

GRAFTON, ILL.
- Rippley Boat Co.

PADUCAH, KY.
- Howard Shipyards & Dock Co.

PITTSBURGH, PA.
- American Bridge Co.
- The Dravo Contracting Company, Engineering Works Dept.
- Elizabeth Marine Ways.
- Hazelwood Dock Co.
- Pittsburgh Coal Co.
- James Rees & Sons Co.

POINT PLEASANT, W. VA.
- Enterprise Marine Dock Co.
- Kanawha Dock Co.
- Point Pleasant Dry Dock Co.

QUINCY, ILL.
- Quincy Marine Ways.

GREAT LAKES

ASHTABULA, OHIO
- Great Lakes Engineering Works.

BAY CITY, MICH.
- James Davidson.

BENTON HARBOR, MICH.
- Dachel-Carter Shipbuilding Co.

BUFFALO, N. Y.
- Buffalo Dry Dock Co.
- Buffalo Marine Construction Corporation.
- Ferguson Steel & Iron Co.
- The Lake Shipbuilding Co.

CHICAGO, ILL.
- Chicago Shipbuilding Co.
- Kraft Ship Yard & Dry Dock Co.

CLAYTON, N. Y.
- Clayton Ship & Boat Building Corporation.
- L. E. Fry & Co., Inc.

CLEVELAND, OHIO
- Ohio Shipbuilding Co.
- The American Ship Building Co.
- The Great Lakes Towing Co.

DETROIT, MICH.
- Detroit Shipbuilding Co.
- Great Lakes Engineering Works.
- Imperial Shipbuilding Corp'n.

DULUTH, MINN.
- McDougall-Duluth Company.
- Marine Iron & Shipbuilding Company.

ECORSE, MICH.
- Great Lakes Engineering Works.

FERRYSBURG, MICH.
- Johnston Bros.

GREEN BAY, WIS.
- Northwest Engineering Works.
- P. F. Thrall.

KEWAUNEE, WIS.
- Wisconsin Shipbuilding & Navigation Corp.

LEVANNA, OHIO
- Barrett Mill & Lumber Co.

LORAIN, OHIO
- American Shipbuilding Co.

LUDINGTON, MICH.
- Lunde Boat Bldg. Co.

MANISTEE, MICH.
- Manistee Ship Bldg. Co.

MANITOWOC, WIS.
- Burger Boat Company.
- Manitowoc Shipbuilding Co.

MARINE CITY
- Kenyon's Shipyard Company.
- Sydney C. McLouth.

MILWAUKEE, WIS.
- Fabricated Ship Corporation.
- Great Lakes Boat Building Corporation.
- Milwaukee Dry Dock Co.

MONTAGUE, MICH.
- The Montague Iron Works.

MUSKEGON, MICH.
- Peninsula Shipbuilding Corporation.

OGDENSBURG, N. Y.
- The St. Lawrence Marine Railway.

OSWEGO, N. Y.
- The Foundation Co.
- J. H. & T. C. Goble.

PORT CLINTON, OHIO
- The Matthews Company.

PORT HURON, MICH.
- The Foundation Company.
- Wolverine Dry Dock.

RACINE, WIS.
- Racine Boat Company.

ROCHESTER, N. Y.
- Rochester Boat Works, Inc.

ROCKY RIVER, OHIO.
- The Rocky River Dry Dock Company.

SAULT STE. MARIE, MICH.
- Heckler Bros.

SAGINAW, MICH.
- Saginaw Shipbuilding Company.

STURGEON BAY, WIS.
- Leatham & Smith Towing & Wrecking Co.
- Universal Shipping Co.

SUPERIOR, WIS.
- Globe Shipbuilding Company.
- Superior Shipbuilding Co.
- Whitney Brothers Company.

TOLEDO
- The Toledo Shipbuilding Co.

WASHBURN, WIS.
- Anchor Shipbuilding Co.

WEST DULUTH, MINN.
- Marine Iron & Shipbuilding Works.

PACIFIC COAST

Alaska

JUNEAU
- Alaska Dry Dock & Mfg. Co.

Washington

ABERDEEN
- Gray's Harbor Motorship Corporation.

ANACORTES
- Sloan Shipyard Corporation.

EVERETT
- Pacific Coast Shipbuilding Co.

HADLOCK
- Hadlock Shipbuilding Co.

HOUGHTON
- Anderson Shipbuilding Corporation.

HOQUIAM
- Matthews Shipbuilding Co.

OLYMPIA
- Sloan Shipyards Corp.

RAYMOND
- Sanderson & Porter.

SEATTLE
- Allen Shipbuilding Company.
- Ames Shipbuilding & Dry Dock Company.
- J. F. Duthie & Co.
- Elliott Bay Shipbuilding Co.
- Inter-Ocean Barge & Transport Company.
- McAteer Ship Bldg. Co.
- Maritime Boat and Engine Works, Inc.
- Meacham & Babcock Shipbuilding Co.
- National Shipbuilding Co.
- National Steel Construction Co.
- Nilson & Kelez Shipbuilding Corporation.
- Paterson-MacDonald Shipbuilding Co.
- J. H. Price Shipbuilding Company.
- Puget Sound Bridge & Dredging Co.
- Seattle North Pacific Shipbuilding Co.
- Skinner & Eddy Corporation.
- Tregoning Boat Company.
- West Waterway Boat Building Company.
- Wilson Shipyards.

SOUTH BELLINGHAM
- Pacific American Fisheries.

SOUTH BEND
- South Bend Shipyard Co., Inc.

TACOMA
- American Concrete Pipe & Shipbuilding Company.
- The Foundation Co.
- Seaborn Shipyards Company.
- Tacoma Ship Building Co.
- Todd Dry Dock and Construction Corp.
- Wright Ship Yards.

VANCOUVER
- Motorship Construction Co.
- G. M. Standifer Construction Corp.

WINSLOW, WASH.
- D. W. Hartzell, Inc.

Oregon

ASTORIA
- McEachern Ship Co.
- Geo. F. Rodgers & Company.
- Wilson Shipbuilding Company.

COLUMBIA CITY
- Sommarstrom Shipbuilding Co.

MARSHFIELD
- Coos Bay Shipbuilding Company.

NORTH BEND
- Kruse & Banks Shipbuilding Company.

NORTH PORTLAND
- G. M. Standifer Construction Corp.

PORTLAND
- Albina Engine & Machine Works, Inc.
- Coast Ship Building Co.
- Columbia Engineering Works.
- Columbia River Ship Building Corp.
- Grant Smith-Porter Ship Company.
- The Foundation Co.
- Kiernan & Kern.
- Northwest Steel Co.
- Peninsula Shipbuilding Company.
- Supple-Ballin Shipbuilding Corp.
- Willamette Shipbuilding Co.

ST. HELENS
- St. Helens Shipbuilding Co.

California

BAY POINT, CONTRA COSTA COUNTY
- Pacific Coast Shipbuilding Co.

BENICIA
- Benicia Shipbuilding Corp.

EAST OAKLAND
- Hanlon Dry Dock & Shipbuilding Co., Inc.

EUREKA
- Hammond Lumber Company.

LONG BEACH
- Long Beach Shipbuilding Co.

OAKLAND
- Apex Manufacturing Co., Oakland, Emeryville, Cal.
- Hanlon Dry Dock & Shipbuilding Co.
- Moore Shipbuilding Company.
- San Francisco Ship Building Co.
- Union Construction Co.

PITTSBURGH
- B. P. Lanteri.

SAN DIEGO
- Pacific Marine and Construction Company.
- San Diego Marine Construction Co.
- San Diego Shipbuilding & Dry Dock Co.

SAN FRANCISCO
- C. L. Arques.
- Bowes & Andrews (Ship Repairing).
- Main Iron Works.
- Pacific Coast Shipbuilding Company.
- Rolph Shipbuilding Company.
- Union Iron Works Co.
- Western Pipe & Steel Co. of California.

SAN PEDRO
- Los Angeles Shipbuilding & Dry Dock Co.
- Southwestern Shipbuilding Company.

SO. SAN FRANCISCO
- Schaw Batcher Shipbuilding Co.

WILMINGTON
- R. J. Chandler Shipbuilding Co.
- Fulton Shipbuilding Company.
- West Coast Shipbuilding Co.

WOOD SHIPS CONTRACTED FOR AND CONTRACTS PENDING BY DISTRICTS AND DESIGNS

District	Design	Contracted For and Pending		†Delivered		Being Fitted Out in Wet Basin		On Ways		Balance on Contract	
		Total No. Ships	Total Tonnage	No.	Tons	No.	Tons	No.	Tons	No.	Tons
North Atlantic	Ferris	91	318,500	16	56,000	30	105,000	35	122,500	10	35,000
	Continental	1	1,500					1	1,500		
Midd'e Atlantic	Ferris	32	112,000			4	14,000	17	59,500	11	38,500
Southern	Ferris	89	311,500	14	49,000	20	70,000	36	126,000	19	66,500
	Dougherty	6	30,000							6	30,000
Gulf	Ferris	78	273,000	2	7,000	21	73,500	34	119,000	21	73,500
	Dougherty	34	164,000	2	9,400	6	28,200	7	33,800	19	92,600
Southern Pacific	Ferris	43	150,500	4	14,000	11	38,500	20	70,000	8	28,000
	Hough	13	45,500	11	38,500	2	7,000				
Northern Pacific	Allen	1	3,650			1	3,650				
	Pac.-Amer.	7	24,500	1	3,500	3	10,500	3	10,500		
	Patt.-Mc-Donald	4	19,200							4	19,200
	Grays Harbor	27	108,800	7	28,000	10	40,000	6	24,400	4	16,400
	Ferris	105	367,500	23	80,500	31	108,500	43	147,000		
District No. 11	Ballin	20	90,000			2	9,000	7	31,500	11	49,500
	Hough	26	91,000	14	49,000	10	35,000	2	7,000		
	Peninsula	12	48,000	1	4,000	7	28,000	4	16,000		
	Ferris	38	308,000	14	49,000	30	105,000	28	98,000	16	56,000
Great Lakes	Lake & Ocean	1	2,500	1	2,500						
Grand Total		678	2,469,650	110	390,400	188	675,850	242	866,700	138	536,700

WOOD SHIPS CONTRACTED FOR AND CONTRACTS PENDING BY DESIGNS

	Design	Total No. Ships	Total Tonnage	Delivered		Being Fitted Out in Wet Basin		On Ways		Balance on Contracts	
				No.	Tons	No.	Tons	No.	Tons	No.	Tons
	Allen	1	3,650			1	3,650				
	Ballin	20	90,000			2	9,000	7	31,500	11	49,500
	Continental	1	1,500					1	1,500		
	Dougherty	40	194,000	2	9,400	6	28,200	7	33,800	25	122,600
	Ferris	526	1,841,000	73	255,500	147	514,500	212	742,000	94	329,000
	Grays Harbor	27	108,800	7	28,000	10	40,000	6	24,400		16,400
	Hough	39	136,500	25	87,500	12	42,000	2	7,000		
	Lake & Ocean	1	2,500	1	2,500						
	Pac. Amer.	7	24,500	1	3,500	3	10,500	3	10,500		
	Patt.-Mc-Donald	4	19,200							4	19,200
	Peninsula	12	48,000	1	4,000	7	28,000	4	16,000		
Grand Total		678	2,469,650	110	390,400	188	675,850	242	866,700	138	536,700

WOOD BARGES CONTRACTED FOR AND PENDING

District	D. W. T. Per Ship	Contracted For and Pending		Delivered		Being Fitted Out in Wet Basin		On Ways		Balance on Contracts	
		Total No. Ships	Total Tonnage	No.	Tons	No.	Tons	No.	Tons	No.	Tons.
North Atlantic		17	46,500					16	44,000	1	2,500
Middle Atlantic		7	17,500					7	17,500		
Southern		5	12,500					5	12,500		
Gulf		7	16,500					7	16,500		
Southern Pacific		1	3,500			1	3,500				
Northern Pacific		9	40,950			1	3,650	5	23,650	3	13,650
Grand Total		46	137,450			2	7,150	40	114,150	4	16,150

WOOD TUGS CONTRACTED FOR AND CONTRACTS PENDING

District	Design	Contracted For and Pending Number	Delivered Number	Being Fitted Out in Wet Basin Number	On Ways Number	Balance on Contracts Number
Entire Country	Ocean	46		13	20	13
	Harbor	94		6	43	45
Total		140		19	63	58

Twin-Screw Troopship of 13,000 Tons D.W.

Three-Deck Combined Passenger and Cargo Vessel of 20,900 Tons Displacement on Draft of 31 Feet 9 Inches—Speed, 14 Knots

ONE of the most important classes of vessels authorized by the Shipping Board during the war was a fleet of twin-screw three-deck troopships designed to carry a total deadweight of 13,000 tons on a mean draft of 31 feet 9 inches. While in use as troopships, the vessels will have accommodations for about 2,700 troops, and, at the same time, will carry 7,000 tons deadweight. The designed speed is 14 knots, but reserve power is provided with the original intention of giving the ship, while in the war zone and lightened in draft, the necessary power to obtain a speed of 15 knots.

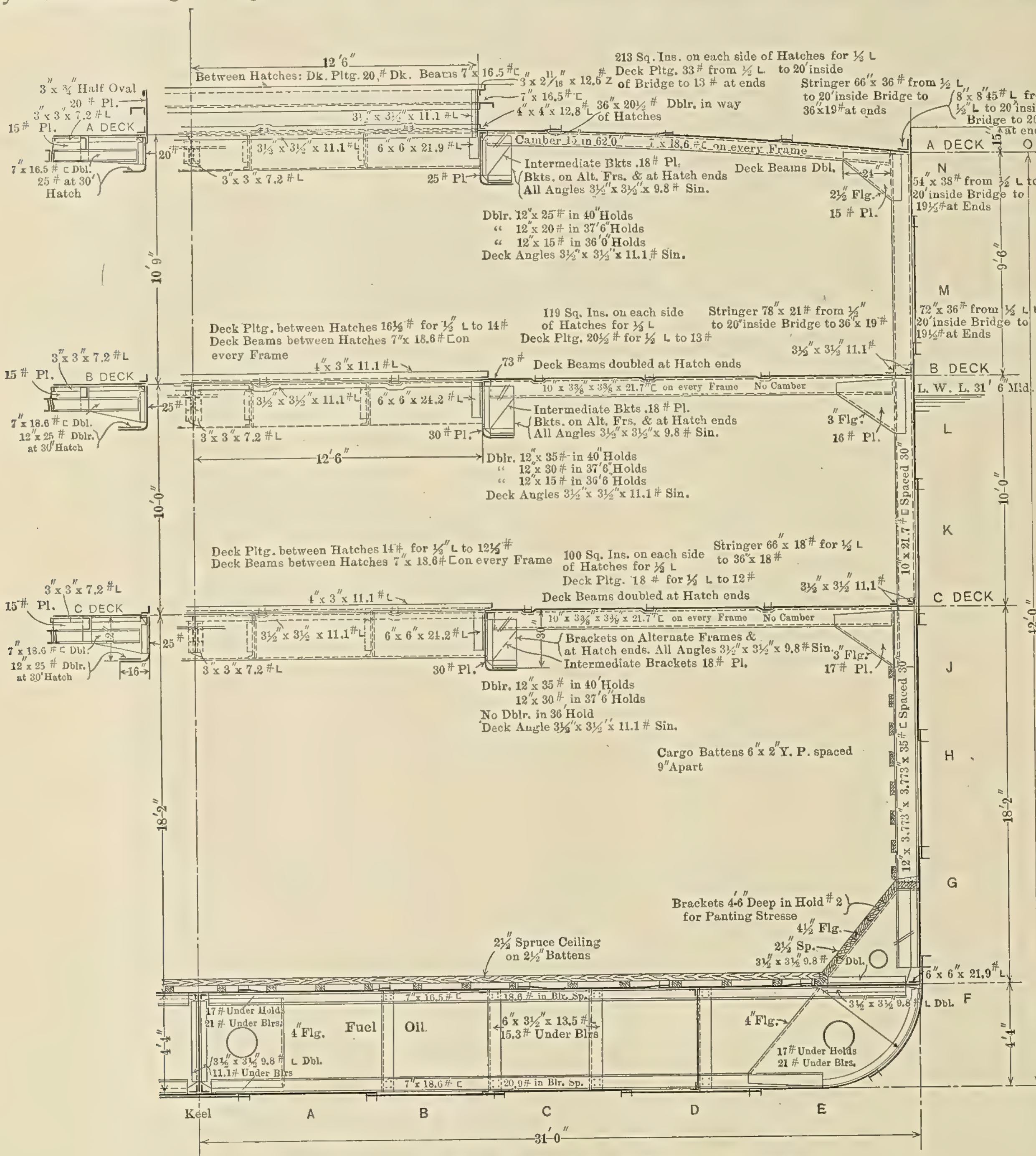


Fig. 1.—Section Through Hold of 13,000-Ton Troopship

Although these vessels were originally designed as troopships, and are being constructed as such, they can readily be converted into combined passenger and cargo steamers for commercial service. Orders for seven of these vessels were placed with the New York Shipbuilding Corporation, Camden, N. J., by the Shipping Board.

The principal dimensions are as follows:

Length overall	522 feet 6 inches
Length per classification rules	502 feet
Beam, molded	62 feet
Depth to *A* deck	42 feet
Depth to *B* deck	32 feet 8 inches

TWIN-SCREW TROOPSHIP OF 13,000 TONS DEADWEIGHT

Designed and Built by the New York Shipbuilding Corporation, Camden, N. J.

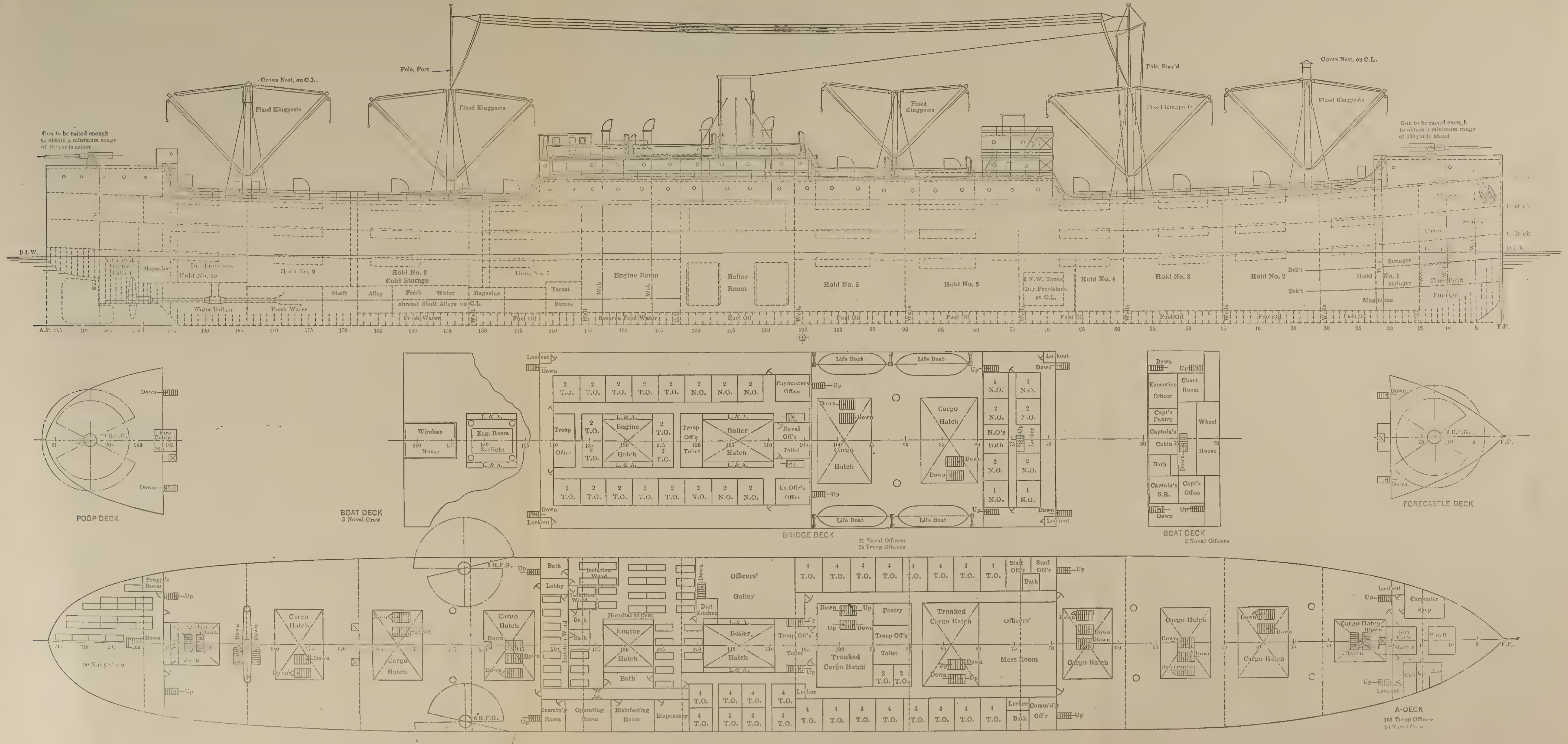


Fig. 2.—Profile and Deck Plans

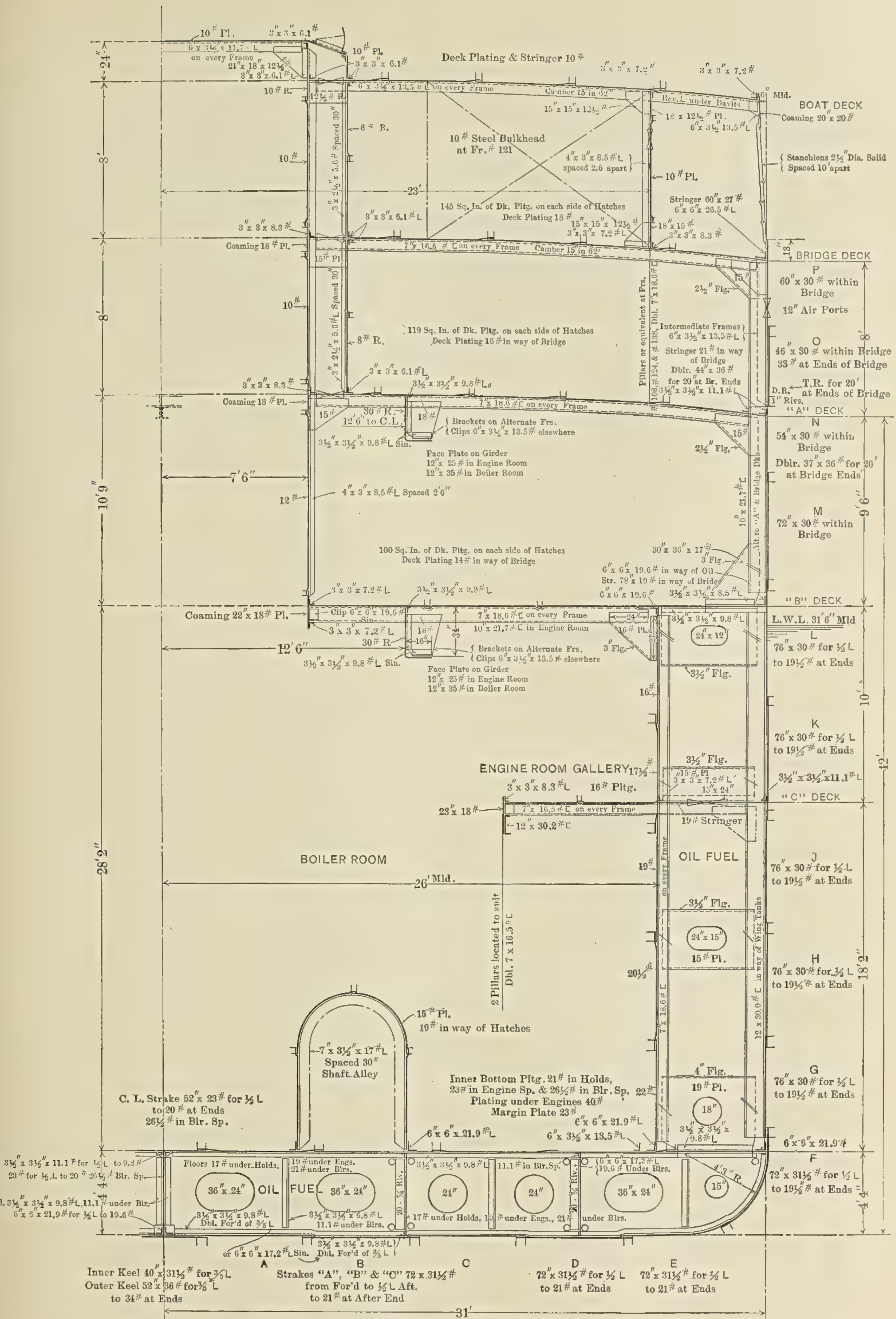


Fig. 3.—Midship Section of 13,000-Ton Troopship

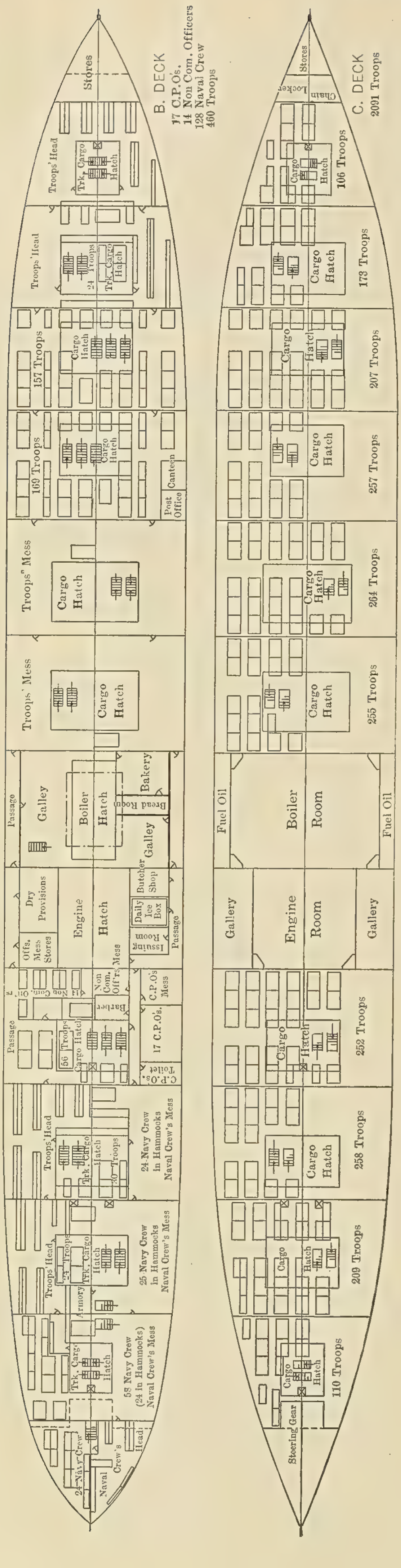


Fig. 4.—General Arrangement Plans of *B* and *C* Decks

Designed draft, full load	31 feet 9 inches
Corresponding displacement, about	20,900 tons
Corresponding deadweight capacity, about	13,000 tons
Indicated horsepower	7,000
Speed on trial	14½ knots
Trial draft	24 feet
Total cubic capacity, about	655,000 cubic feet
Deadweight capacity as a trooper (on trial)	7,000 tons
Number of passengers (troops)	2,700

The hull is designed with a straight stem and cruiser stern with three complete steel decks, designated as *A, B* and *C* decks, with steel deckhouses amidships and a short poop and forecastle and a long bridge.

General Arrangement

The tops of the deckhouses are carried out to the sides of the vessel to form a boat deck which is of steel unsheathed. A wooden wheel house and chart room are placed forward on the boat deck, and a similar house for winches aft. A flying bridge is placed at the level of these structures at each end of the superstructure.

A double bottom extends from the forward peak to the after end of No. 8 hold and is divided by transverse members into ten main compartments on each side. The compartments under the engine room are arranged to carry feed water only, while all other compartments are arranged for carrying either fuel oil or water ballast.

Above the tank top the hull is subdivided by thirteen transverse watertight bulkheads, all of which extend up to *A* deck, giving six cargo holds forward and four aft of the machinery space. Separate compartments are provided for the engines and boilers. Wing bulkheads, extending up to *B* deck, are fitted in the boiler room to form side tanks for fuel oil.

All accommodations for officers are provided above decks. The *B* and *C* decks are used for accommodating about 2,500 troops, in addition to the naval crew.

Each of the regular cargo holds is reached through large hatches in all of the decks. Each hatch is served by two cargo booms located at derrick posts, each boom being served by a single-drum single-geared winch.

As a troop transport the vessel is subdivided for a three-compartment ship with 30 percent permeability for the cargo and troop spaces and engine and boiler spaces, this condition to obtain with the vessel carrying 7,000 tons total deadweight.

Hull Construction

The hull is built with transverse framing, the frames being spaced 30 inches center to center amidships and reduced at the ends. There is no sheer amidships, but at the ends the sheer is quite pronounced. The *B* and *C* decks have no camber, while all weather decks have a camber of 15 inches in 62 feet.

Above the tank top the frames are channel section except in the peaks and in way of excessive bevel, where they are built up of angles and reverse angles. Solid floors are fitted on every third frame with angle frames and reverse frames. Double frames or their equivalent are fitted on every floor from three-fifths length forward to the collision bulkhead.

The center keelson is continuous throughout the length of the ship. Two longitudinals are fitted on each side of the center keelson, intercostal between solid floors with the thickness increased under the boilers.

No web frames are fitted in the cargo holds. The staying and stiffening of the fuel oil bunkers in the boiler space render the fitting of web frames in these spaces unnecessary. Two web frames are fitted in the engine room and webs are also fitted as panting frames at the

ends. No side stringers are fitted amidships, but short stringers are fitted at the ends to resist panting.

All of the decks are steel plated, riveted to channels on every frame. On *B* and *C* decks the deck beams are joggled down with the plating worked flush. The deck beams stop at the inner face of the frames.

The cargo holds are free from pillars, strength being provided by girders well supported at the bulkheads. Pillars are fitted only at the ends of the ship and locally.

The steam windlass, of the spur-geared type, triple-geared, is located under the forecastle with the engine on the same bed. There are twenty cargo winches, sixteen of which are 8¼ inches by 8 inches, double-cylinder, single-drum, single-geared reversible winches with one winch head on each winch, and four others, two forward and two aft, of the double-geared single-drum type, each with two large winch heads. In connection with the steam heating system, a system of mechanical ventilation is fitted for the troop spaces. Steam coils are placed in the discharge ducts of the mechanical ventilating system, which is operated by electrically driven fans.

Electricity is furnished by three 50-kilowatt turbo generating sets, and an auxiliary lighting circuit, operated by a 25-volt storage battery, is provided on the boat deck for the illumination of lifeboats and handling gear.

The refrigerating plant, of the brine circulating system, consists of two main machines, each of about 10 tons capacity. Each machine is self-contained and includes the compressor engine and all necessary apparatus.

Propelling Machinery

Propulsion is by two sets of four-cylinder triple-expansion reciprocating engines with cylinders 24 inches, 40½ inches, 54 inches and 54 inches diameter by 45 inches stroke, supplied with steam at 220 pounds pressure by six single-end Scotch boilers, 15 feet 3 inches mean diameter and 11 feet 6 inches long between heads, giving a total heating surface of about 16,000 square feet.

The engine cylinders are mounted on four front and four back cast iron housings of box section. The fore-and-aft arrangement of the cylinders is low pressure, high pressure, intermediate pressure, low pressure. Only the high-pressure cylinder is fitted with a liner. The high-pressure and intermediate-pressure cylinders each have one piston valve, while each of the low-pressure cylinders has one double-ported flat slide valve. The intermediate- and low-pressure valves are provided with Lovekin assistant cylinders.

Propellers

The propellers are three-bladed of the built-up type, about 16 feet 6 inches diameter. The propeller shafts are 15¾ inches diameter and the line shafting 13⅞ inches diameter.

There are two main condensers, each independent and containing 4,500 square feet of cooling surface. There are also two centrifugal main circulating pumps with 16-inch suction and discharge connections; each of the pumps has a capacity of 5,000 gallons per minute against a 25-foot head. The pumps are driven by single-cylinder reciprocating engines 10 inches diameter by 10 inches stroke. There are also two main air pumps of the vertical twin-beam single-acting type with one steam cylinder and two air cylinders, 14 inches and 28 inches by 18 inches.

Auxiliaries

The engine room auxiliaries include a feed water heater with a capacity for heating 125,000 pounds of water per hour from 90 degrees to 212 degrees F. with exhaust steam at 5 pounds gage; a feed and filter tank of 1,400 gallons capacity; two injectors of the double-tube type with 2-inch suction and discharge; two evaporators, each with a capacity of 25 tons per twenty-four hours, and two distillers, each to produce 3,000 gallons of potable water in twenty-four hours. There is also an auxiliary condenser with a cooling surface of 1,000 square feet.

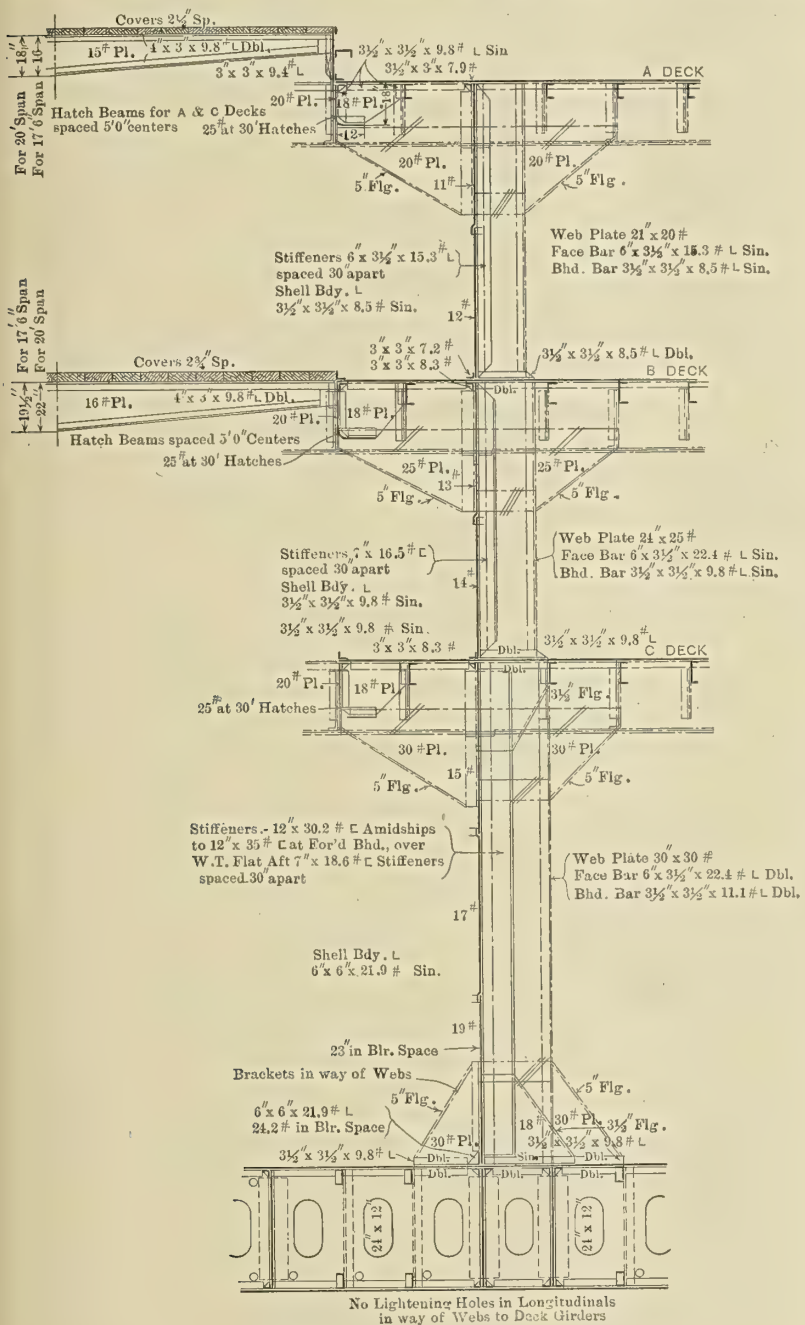


Fig. 5.—Details of Bulkhead Construction

The engine room auxiliary equipment includes the following pumps:

Pumps

Two vertical simplex main feed, 14 inches and 10 inches by 24 inches.

One vertical simplex auxiliary feed, 10 inches and 7 inches by 24 inches.

One horizontal duplex ballast, 10 inches and 12 inches by 12 inches.

One horizontal duplex, fire and bilge and general service, 12 inches and 8½ inches by 12 inches.

One horizontal duplex sanitary, 7½ inches and 9 inches by 10 inches.

One vertical simplex engine room bilge, 6 inches and 7 inches by 12 inches.

Two horizontal duplex fresh water, 7½ inches and 6 inches by 10 inches.

One horizontal duplex drinking water, 4½ inches and 3¾ inches by 4 inches.

One horizontal duplex evaporator feed, 7½ inches and 6 inches by 10 inches.

One horizontal simplex combined air and circulating, 10 inches and 12 inches and 14 inches by 12 inches.

One vertical duplex oil transfer, 7½ inches and 9 inches by 10 inches.

Two vertical duplex oil service, 7½ inches and 4½ inches by 10 inches.

One horizontal duplex ice machine condenser circulating, 6 inches and 5¾ inches by 6 inches.

Two horizontal duplex brine circulating, 6 inches and 5¾ inches by 6 inches.

The boiler room auxiliaries, in addition to the apparatus in connection with the mechanical atomizing oil burners, include two forced draft fans direct connected to single cylinder vertical engines each capable of delivering 28,000 cubic feet of air per minute against a static pressure of 3 inches of water.

Oil Tank Steamer of 10,100 Tons D. W.

Type of Vessel Authorized by the Shipping Board—Cargo Space Divided Up Into 18 Main and 8 Summer Tanks

As a part of the fleet of oil tankers ordered by the United States Shipping Board Emergency Fleet Corporation during the war, the Sparrows Point (Maryland) plant of the Bethlehem Shipbuilding Corporation is building ten single-screw tankers of 10,100 tons deadweight capacity each. In these vessels the machinery is located aft and the pump room forward. There are duplicate electric light sets, and all the auxiliary machinery usually fitted on oil tankers. The dimensions of the vessels are as follows:

Length between perpendiculars	435 feet
Beam, molded	56 feet
Depth, molded to upper deck	33 feet 6 inches
Height between decks	7 feet 6 inches
Block coefficient	0.775
Draft, loaded	26 feet
Deadweight capacity at above draft	10,100 tons
Number of main oil tanks	18
Number of summer tanks	8
Total capacity main tanks for fuel oil	10,140 tons

Capacities of Oil Tanks

	Tons
Main fuel tank	844
Main fuel wings	75
Deep tank forward	820
Total fuel oil	11,879
Refined oil, summer tanks	899
Refined oil, main cargo tanks	8,241
Total refined oil	9,140

The hull is built on the Isherwood system of longitudinal framing, with a straight stem and elliptical stern with a poop deck, a bridge house amidships and full topgallant forecastle forward.

Hull Construction

The engine and boiler spaces are of such dimensions and so arranged as to gain a 32 percent deduction for tonnage. Intermediate athwartship bulkheads are fitted, dividing the petroleum cargo spaces into nine compartments, extending from the keel to the top of the expansion trunk. A longitudinal oiltight bulkhead is fitted in the petroleum and fuel compartments and carried through the cofferdam and forward ballast tanks to the collision bulkhead. At the forward end it is extended through the pump room.

The summer tanks are emptied and filled through two 6-inch lines led to the main pumps.

A double bottom, built on the cellular system, is fitted under the engine and boiler room spaces. These tanks are used for fresh water and the fore and after peak tanks for ballast. The forward deep tank may be used for either ballast or fuel oil. The tank under the machinery space is divided fore and aft and athwartships into four tanks for convenience in trimming the vessel.

In all, the hull is subdivided by sixteen bulkheads, including the screen between the engine and boiler rooms, fourteen of which are oiltight and one watertight. The stringers in the holds are stopped at the bulkheads and connected with gussets.

Cargo Oil Piping System

The cargo oil piping system consists of two 16-inch by 14-inch by 24-inch horizontal duplex pumps installed in the pump room. The suction system consists of a 10-inch main on each side of the centerline connecting with the main tanks only. Each main cargo tank has one 8-inch suction. The pumps are so arranged that either separately or together they may discharge into a single 12-inch discharge main running along the upper deck. Two connections, 8 inches diameter, are made from the deck discharge main to the main suction line on each side of the ship for filling or discharging back to each tank through the main suction. There are two 10-inch discharge branches, one forward and one aft, fitted to the main discharge line of the ship. A 10-inch discharge branch is fitted to the main discharge line on each side of the ship amidships. An 8-inch discharge line is extended to the after end of the poop deck.

The deck machinery includes windlass, capstan and winches of the Bethlehem-Moore plant make. Electricity is furnished by two 15-kilowatt sets.

Propelling Machinery

Propulsion is by a single four-bladed built-up propeller, 18 feet diameter, driven by a triple-expansion engine with cylinders 27 inches, 47 inches and 78 inches diameter by 48 inches stroke, supplied with steam at 220 pounds pres-

OIL TANK STEAMER OF 10,100 TONS DEADWEIGHT

Built by Bethlehem Shipbuilding Corporation, Ltd., at Sparrows Point, Md., Plant

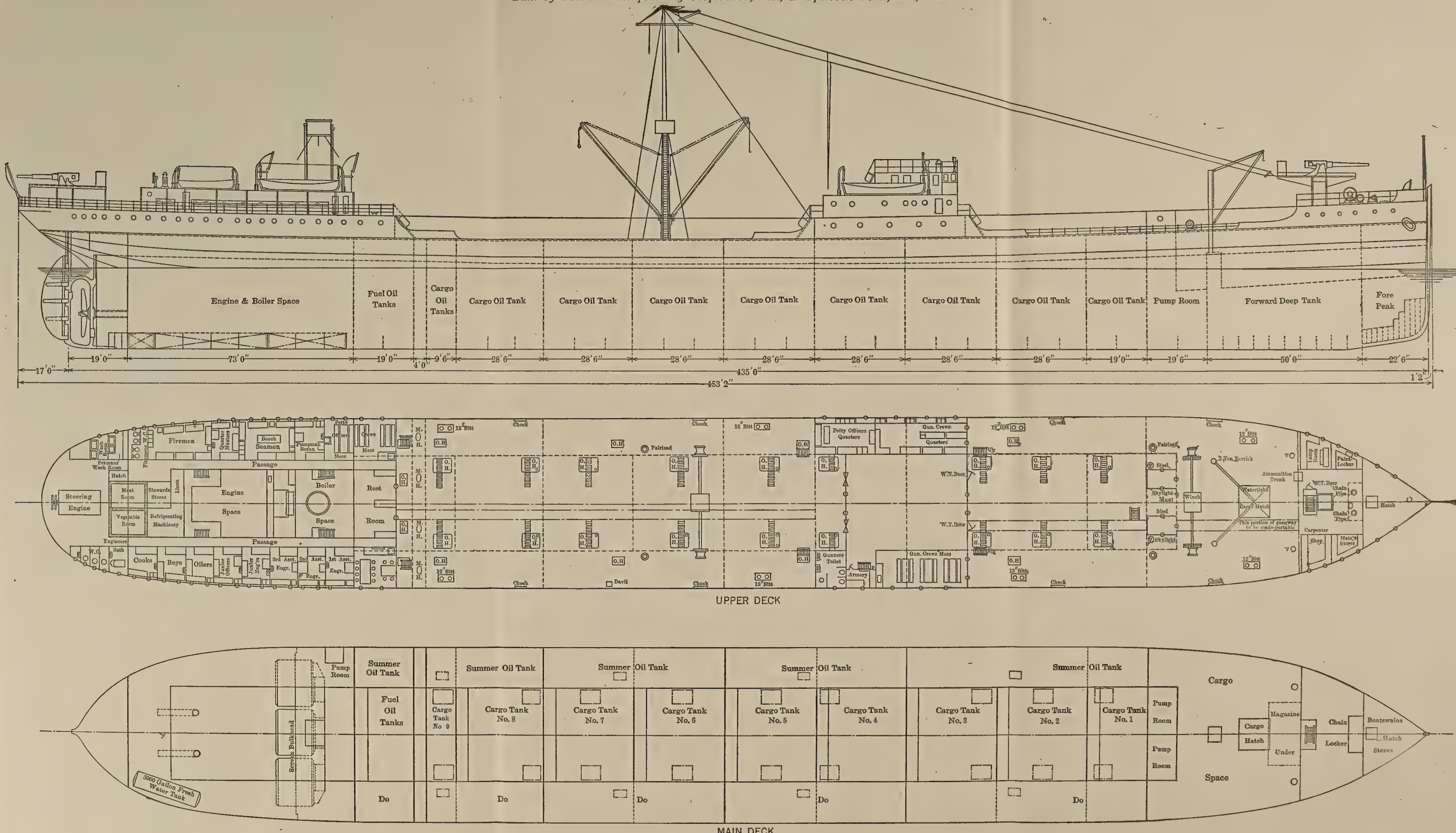


Fig. 1.—Profile and Deck Plans

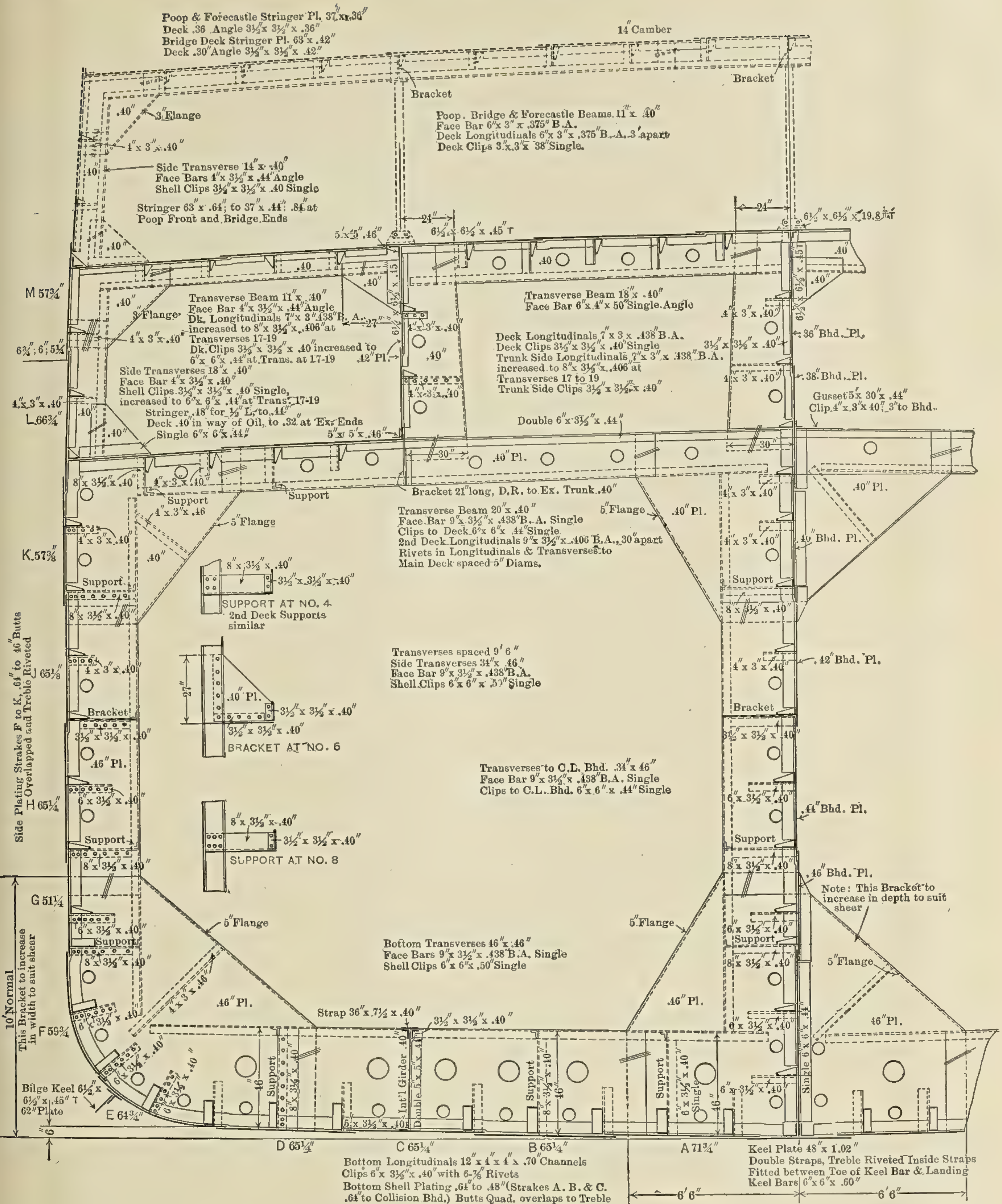


Fig. 2.—Midship Section of 10,100-Ton Oil Tanker

sure by three single-end Scotch boilers 15 feet inside diameter and 11 feet 9 inches long, with a total heating surface of 8,265 square feet. The main condenser has a cooling surface of 4,000 square feet and is designed to produce a vacuum of 26½ inches when running in water at a temperature of 70 degrees F. at sea. An auxiliary condenser is provided with a cooling surface of 600 square feet.

The engine room auxiliaries include the following:

Centrifugal circulating pump with 15-inch suction and 14-inch discharge, diameter of impeller 45 inches.

One feed and filter tank.

One feed water heater designed to raise the feed water from a temperature of 100 degrees to 210 degrees F. at the rate of 55,000 pounds per hour with exhaust steam at 10 pounds pressure.

One evaporator with a capacity of 20 tons in 24 hours.

One distiller with a capacity of 2,000 gallons per twenty-four hours.

One 2-inch diameter injector.

One Edwards air pump, 26 inches diameter by 24 inches stroke, driven off the low-pressure crosshead of the main engine.

Two main bilge and two hot well pumps, each 4½ inches by 24 inches, driven off the low-pressure crosshead.

Pumps

Two vertical simplex feed pumps, 12 inches and 7 inches by 18 inches.

One horizontal duplex fire and general service pump, 12 inches and 8½ inches by 12 inches.

One horizontal duplex bilge pump, 6 inches and 5¾ inches by 6 inches.

One horizontal duplex sanitary pump, 7 inches and 6 inches by 10 inches.

One horizontal duplex fresh water pump, 4 inches and 3¾ inches by 5 inches.

One horizontal duplex evaporator feed pump, 3 inches and 3 inches by 4 inches.

One horizontal duplex bilge pump (in pump room), 6 inches and 5¾ inches by 6 inches.

One horizontal duplex ballast and fuel oil transfer pump (forward), 7 inches and 6 inches by 10 inches.

Two horizontal duplex fuel oil pumps, 6 inches and 4 inches by 6 inches.

Two horizontal duplex cargo pumps, 16 inches and 14 inches by 24 inches.

There is also a refrigerator plant consisting of a 2-ton ammonia ice machine with a capacity for making 200 pounds of ice daily. The fuel oil-burning system is of the Union Iron Works type.

Standard 7,500-Ton Oil Tanker

Single-Screw Vessel Designed for 11 Knots Sea Speed—Type of Propelling Machinery Optional

One of the designs adopted by the United States Shipping Board Emergency Fleet Corporation as a standard for the construction of oil tank steamers calls for a vessel of 7,500 tons deadweight built on the Isherwood system of longitudinal framing with two continuous steel decks from stem to stern and a raised forecastle, bridge and poop. The dimensions of the vessel are:

Length overall	405 feet
Length between perpendiculars	392 feet
Beam, extreme	51 feet 4 inches
Depth, molded to upper deck	30 feet 2 inches
Depth, molded to main deck	22 feet 8 inches
Mean draft	24 feet 3 inches
Block coefficient	0.79

The hull is divided by oiltight and watertight transverse bulkheads and a centerline oiltight bulkhead into compartments forming fourteen main oil tanks and six summer tanks; two fuel oil tanks; a cargo hold forward; a pump room amidships, and machinery space aft.

The vessel is designed for a mean draft not to exceed 24 feet 3 inches, with a drag aft of about 11 inches under the following conditions: Vessel complete ready for sea, steam up and fully loaded (5,450 tons), 1,526,000 gallons of oil weighing 8 pounds per gallon, 1,315 tons of dry cargo, 590 tons of fuel oil, 120 tons of feed water under the boiler space, 25 tons of drinking water, and all outfit, crew, supplies, etc., aboard.

The electric light plant consists of two 10-kilowatt, General Electric, 110-volt, turbo-driven generator sets. The deck machinery includes a 12-inch by 12-inch windlass, an 8-inch by 8-inch capstan and a steam steering gear operated by a Brown telemotor.

The cargo piping consists of a 10-inch line running fore and aft along each side of the longitudinal centerline bulkhead.

Propulsion is by a triple-expansion engine with cylinders 27 inches, 45 inches and 75 inches diameter by 48 inches stroke, designed to give the vessel a speed of 11 knots under load conditions at a 24-foot mean draft with the engine turning at 80 revolutions per minute. Steam is supplied at a working pressure of 190 pounds per square inch by three single-end oil-burning Scotch boilers, 14 feet 8 inches inside diameter and 11 feet long, with a total heating surface of 7,128 square feet.

In place of the reciprocating engine and Scotch boilers, a geared turbine unit of 2,500 shaft horsepower, designed to drive the propeller at a normal speed of 90 revolutions per minute, and oil-fired watertube boilers with a total heating surface of about 9,000 square feet, may be installed.

How the Union Shipbuilding Company Met a War Emergency

BY FRANK G. REINHARDT, JR.

During the war emergency the shipyards were compelled to extend every possible effort to accomplish the programme laid out for them by the Emergency Fleet Corporation. As the drafting department is one of the most important departments in the shipbuilding industry, the Union Shipbuilding Company, Baltimore, Md., established a course in naval architecture to meet the increasing demand of ship draftsmen. The course was inaugurated by H. A. Everett, the naval architect of the company, who appointed efficient teachers to take care of the studies involved. The class was open to men from the mold loft, draftsmen experienced along other lines who had switched over to the shipbuilding industry, and apprentice draftsmen. The only qualifications necessary were to have reached a certain stage in mathematics and to have a fair experience in the use of drafting tools.

Two distinct courses of study were adopted—one in practical shipbuilding, and the other in theoretical naval architecture. The former course consists only of the practical work of construction, from the making of the raw material to the equipped vessel, including subsequent upkeep and repairs. "Practical Shipbuilding," by A. Campbell Holms, surveyor of Lloyd's Register of Shipping, was adopted as the text-book in this course. The other course of study deals with just the reverse of the former, i.e., the theory involved in ship construction. Attwood's "Text Book of Theoretical Naval Architecture" is used as the text in this course.

The method of procedure in the classroom in these

STANDARD 7,500-TON OIL TANKER

Length Overall, 405 Feet 6 Inches; Length Between Perpendiculars, 392 Feet; Beam, Molded, 51 Feet; Depth, Molded, to Upper Deck, 30 Feet 2 Inches

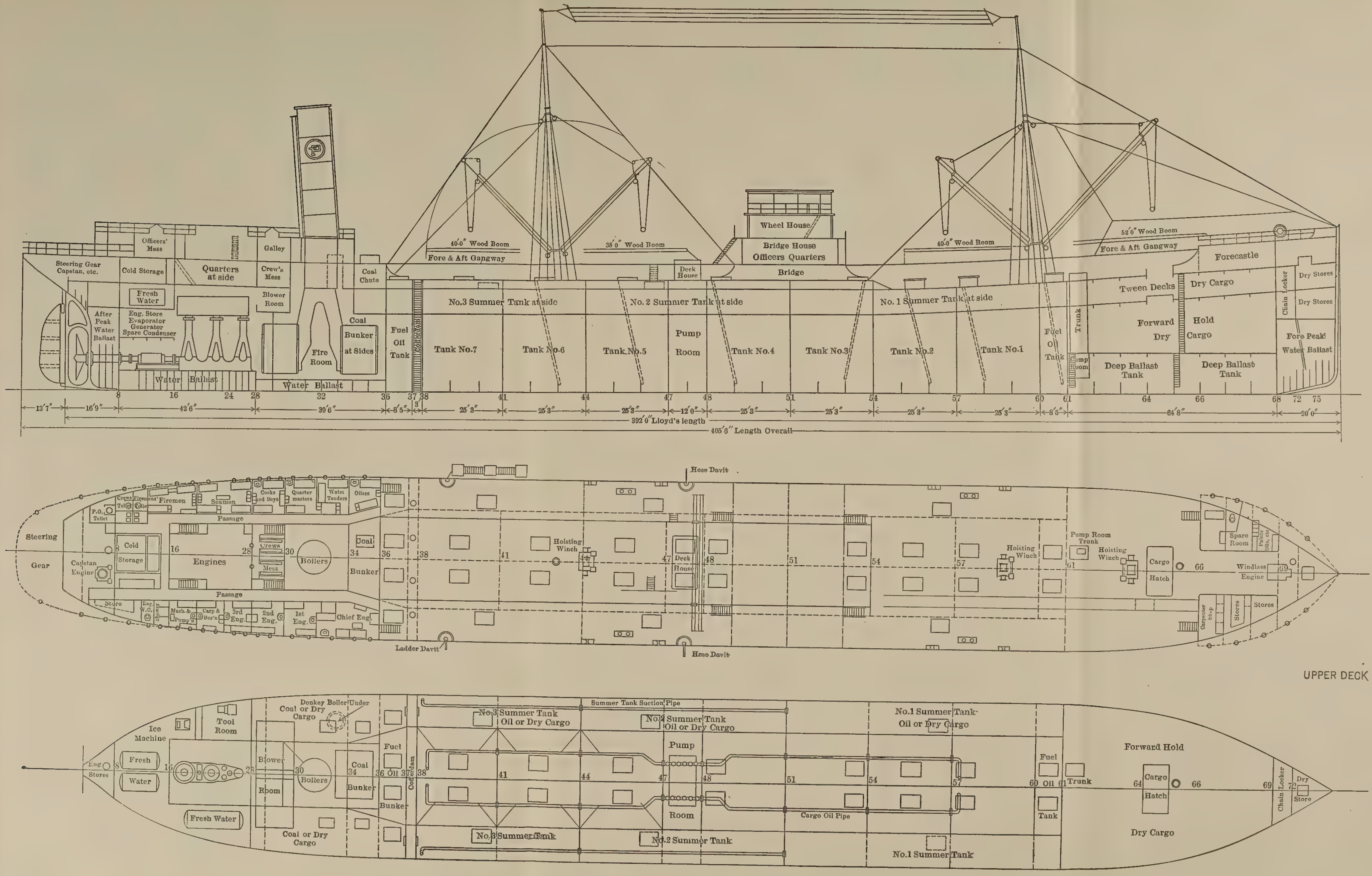


Fig. 1.—Profile and Deck Plans

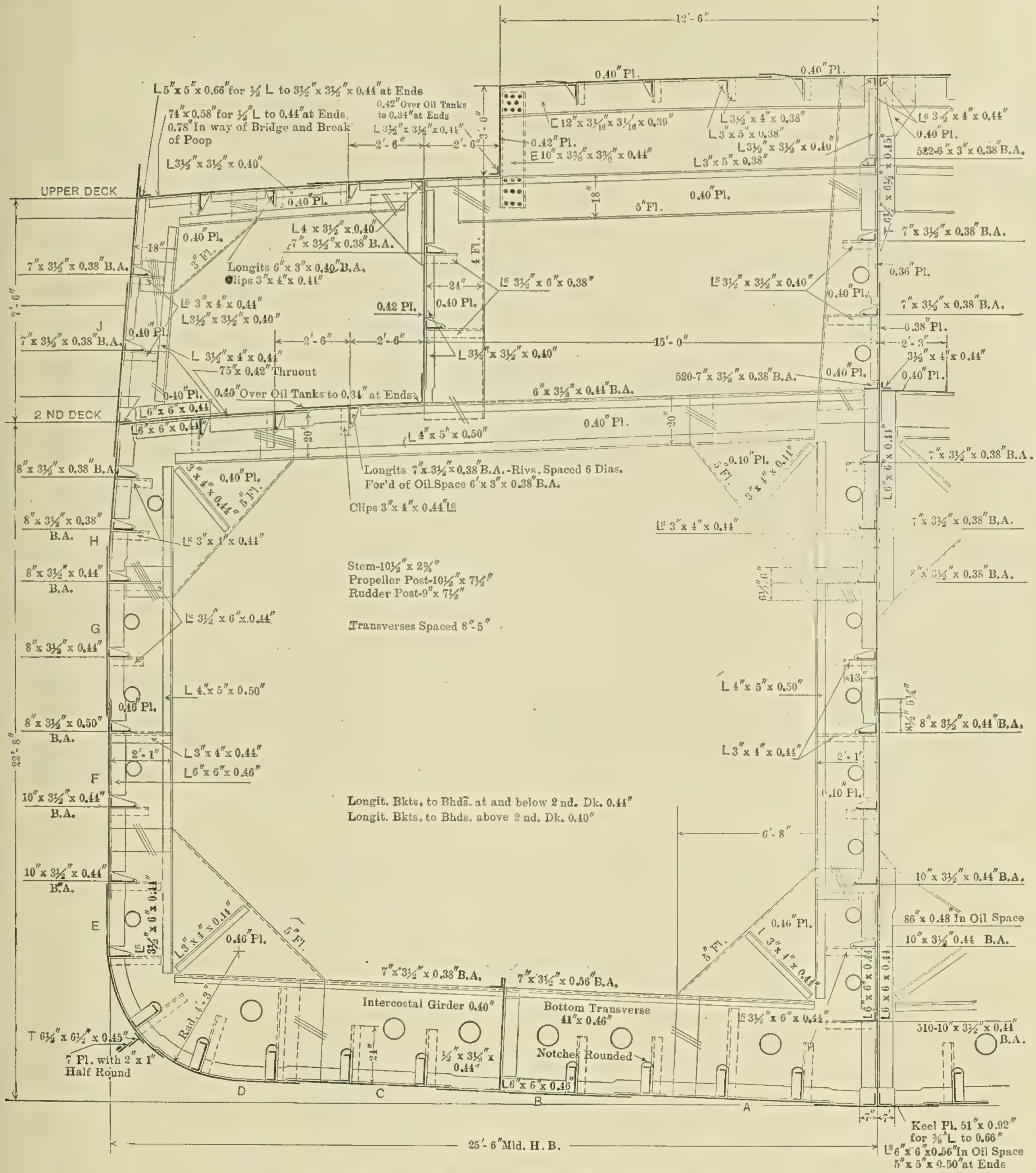


Fig. 2.—Midship Section of 7,500-Ton Oil Tanker

courses is similar to that in a college. Six periods of study with the necessary home work constitute a week, three of which are devoted to practical shipbuilding and three to naval architecture. Examinations are held at opportune times, and the members of the class successfully completing their studies are given better positions, those members who are from the mold loft entering the drafting room as ship draftsmen. In this way the Union Shipbuilding Company met an emergency and was enabled to maintain a progressive drafting force.

High Cost of American Ships.—The high cost of ship construction in the United States, according to Holden A. Evans, president of the Baltimore Dry Docks & Shipbuilding Company, is due to the following: (1) High cost of wages. The wages to-day are double what they were before the war and approximately double the rates paid in Great Britain. (2) The high cost of material. Before the war steel plates could be bought at $1.10, while lately they were $3.25—approximately three times what they were before the war. All other material costs have greatly increased. (3) The inefficiency of a large number of unskilled men taken in the yards, due to the enormous plant expansion. (4) Inefficiency due to the rush of war methods. (5) The inefficiency due to the rapid increase of wages. We have plants and machinery superior to the equipment abroad; we have aggressive and efficient shipyard managers; we have ingenious and intelligent workmen, but we must build on this foundation, and it will take time and money to do this.

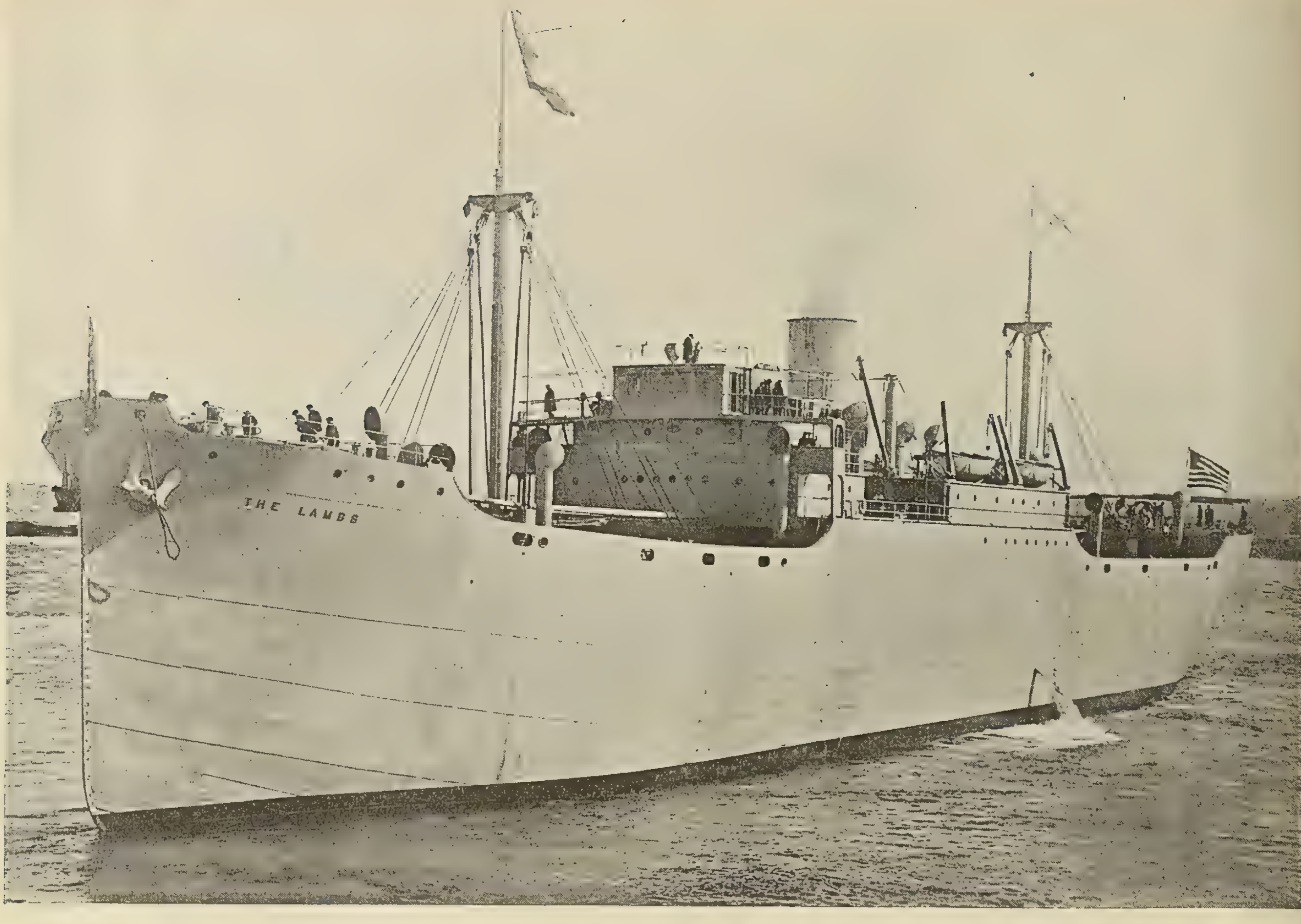


Fig. 1.—One of the 9,600-Ton Geared Turbine Cargo Steamers Built by the Federal Shipbuilding Company, Kearney, N. J.

9,600-Ton Deadweight Cargo Vessel

Economical Shelter Deck Freighter Designed by Federal Shipbuilding Company for Overseas Trade—Longitudinal Framing Adopted

THE standard type of cargo vessel which is being built by the Federal Shipbuilding Company, Kearney, N. J., is a single-screw steamship of 9,600 tons deadweight. The hull is of the shelter deck type, built on the Isherwood system of longitudinal framing, with a straight stem and elliptical stern. There are two complete steel decks and a raised poop, bridge and forecastle. The rigging consists of two steel masts and two derrick posts.

The principal dimensions of the hull are as follows:

Length between perpendiculars	395 feet 6 inches
Beam, molded	55 feet
Depth, molded to shelter deck	34 feet 11 inches
Height of 'tween decks at side	7 feet 11 inches
Draft, maximum	27 feet
Deadweight tonnage	9,600
Shaft horsepower	2,500

Cargo is handled by means of ten 5-ton steel booms, four on the foremast, four on the mainmast, and one on each of the derrick posts. These booms serve five cargo hatches and are handled by ten steam winches, each of the double-cylinder type, 7¼ inches by 10 inches, with single drums and two winch heads.

A double bottom of the cellular type extends throughout the length of the vessel. Under the engines and boilers the double bottom tanks can be used for fresh feed water, and under the holds for either ballast or fuel oil. The double bottom itself is divided into six transverse compartments with a watertight center keelson under the holds. Settling tanks are fitted forward of the boiler room bulkhead, extending from the tank top to the under side of the upper deck plating. The tanks have a combined capacity of about 21,000 gallons.

Five transverse watertight bulkheads divide the hull into four cargo holds. Space in the bridge deck is arranged for carrying either coal or cargo. Tubular pillars are fitted on each side of the centerline on each transverse. All of the hatches have transverse web beams spaced about 4 feet 6 inches apart to take the hatch covers. Cargo battens of 6-inch by 2-inch yellow pine are fitted between the transverses in the holds, and also in the 'tween deck and bridge spaces.

Accommodations are provided for a dining saloon and pantry in a steel deck house at the forward end of the bridge deck. The galley is located at the after end of the engine casing, and the engineers, cooks and stewards are quartered abreast the engine casing. Quarters for the captain and deck officers are located on the boat deck, while the oilers, firemen, sailors, quartermasters, boatswain, carpenter, donkeyman and storekeeper are berthed

9,600-TON DEADWEIGHT CARGO VESSEL

Designed and Built by the Federal Shipbuilding Company, Kearny, N. J.

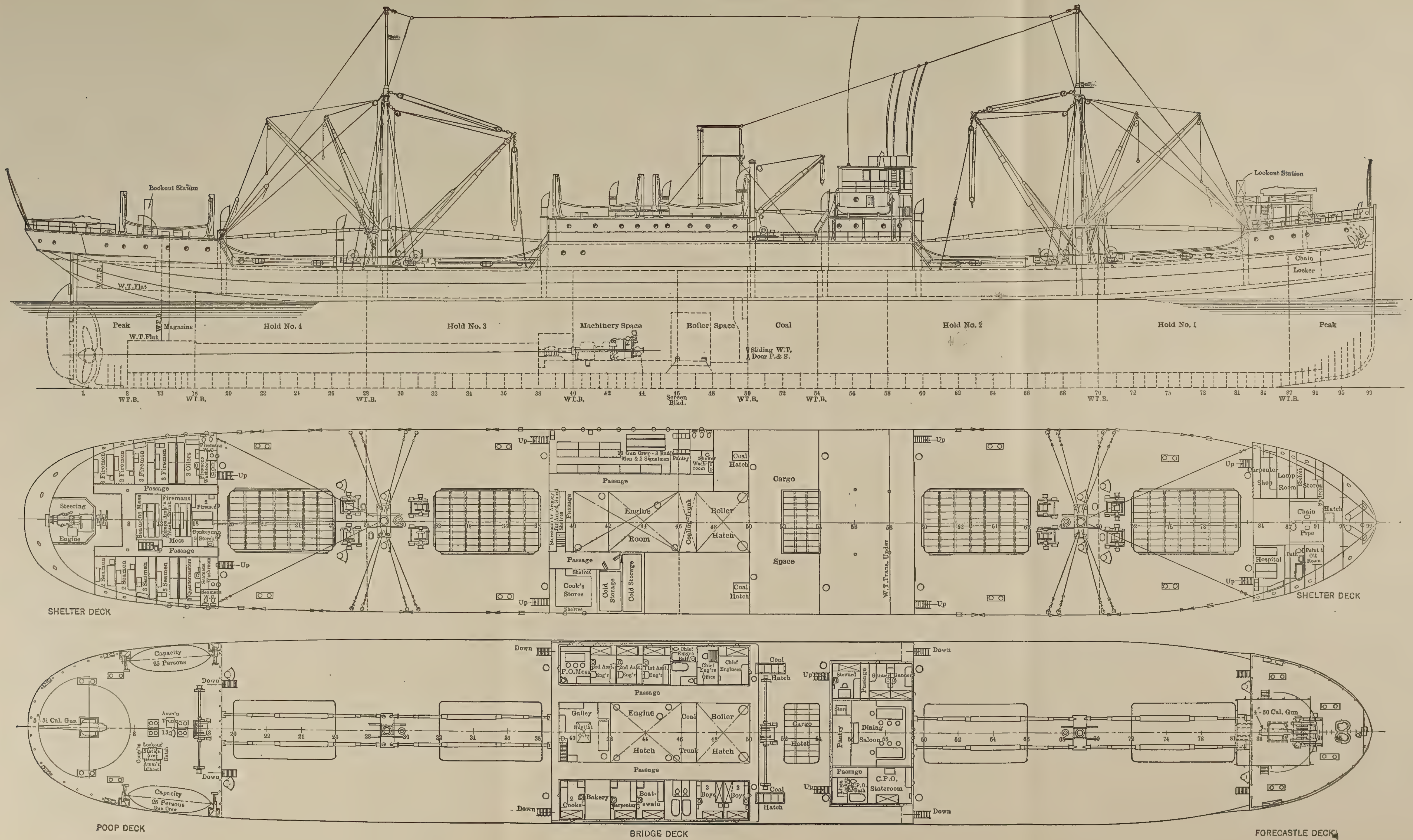
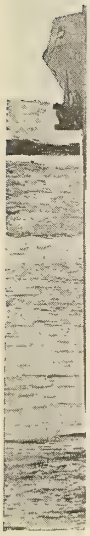


Fig. 2.—Profile and Deck Plans



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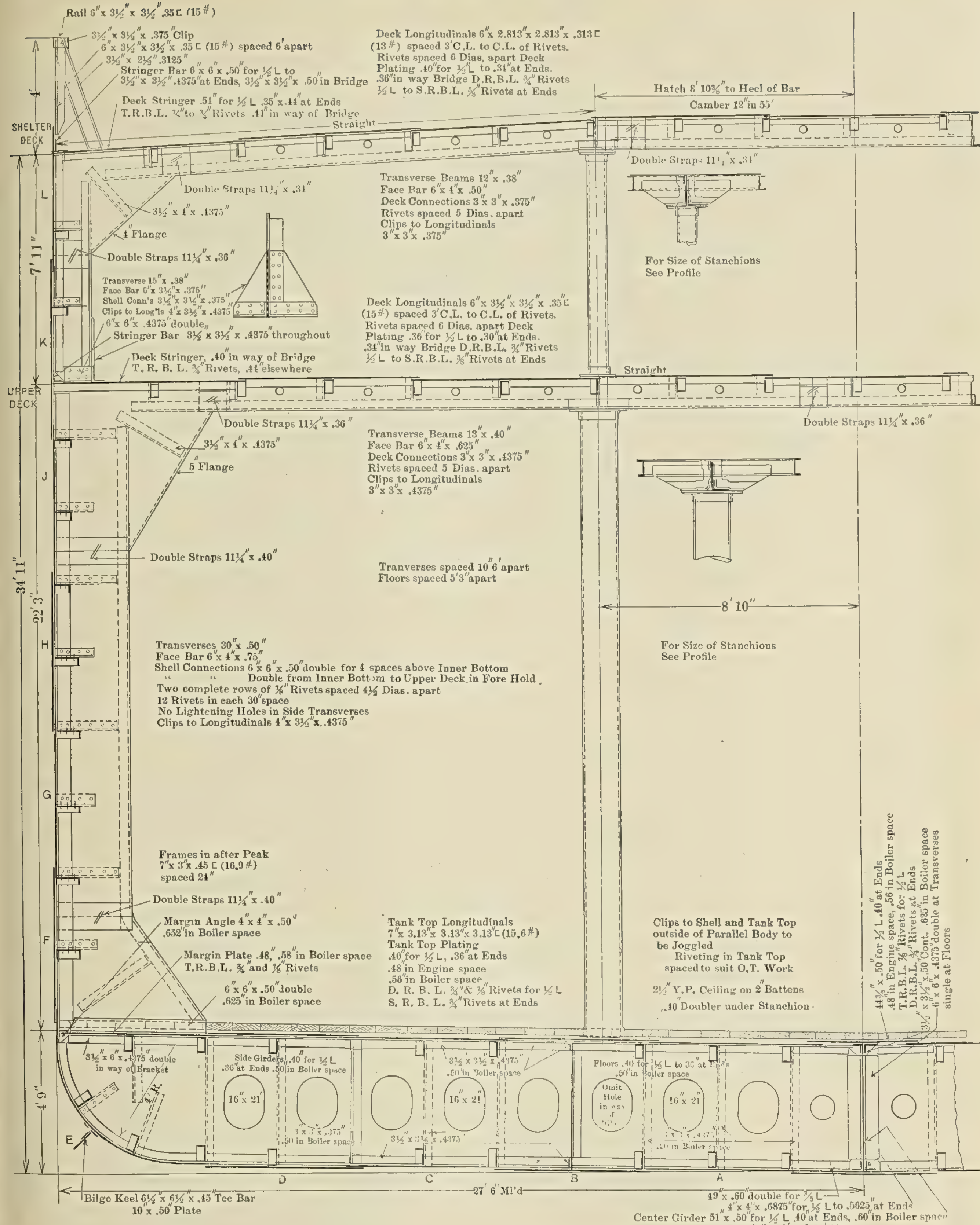


Fig. 3.—Midship Section of 9,600-Ton Cargo Steamer

in the poop. Under the forecastle is a hospital, lamp room, paint room, carpenter shop and store room. The cooks' stores and cold storage rooms are located on the shelter deck abreast the engine casing. An ice machine of two tons' capacity is located on the deck below.

Living quarters throughout the vessel are heated with steam and lighted with electricity provided by two 10-kilowatt, 110-volt, compound wound generator sets, which supply direct current for an 18-inch searchlight and about 165 incandescent lamps.

In addition to the winches already mentioned, the deck machinery includes a steam steering gear, a double-cylinder 10-inch by 10-inch windlass with two wildcats and two winch heads for warping the ship, and a horizontal ballast

pump with a 12-inch steam cylinder and 10-inch water cylinder with a stroke of 12 inches.

Propelling Machinery

The main propelling machinery is located amidships and consists of a geared turbine of 2,500 shaft horsepower supplied with steam at 210 pounds per square inch and 50 degrees superheat by three single-end Scotch boilers. The turbine is of the Curtis type supplied by the General Electric Company and drives the propeller shaft at a speed of 90 revolutions per minute through a double-reduction gear, giving the vessel a speed of 11 knots. Incorporated in the casing of the ahead turbine is an astern turbine, which is designed to develop not less than two-thirds the full speed ahead torque on not more than two-thirds of the full speed revolutions. With steam at 190 pounds gage and 50 degrees superheat at the throttle and 28 inches vacuum in the condenser, the steam consumption of the turbine at normal speed at full power is guaranteed to be not more than 12 pounds per shaft horsepower per hour.

The propeller is a solid four-bladed right-hand screw, 17 feet diameter, attached to a 14-inch propeller shaft. The line shafting is 13 inches diameter, and the thrust shaft 13¾ inches diameter. The thrust bearing is of the horseshoe type.

The turbine oiling system provides for draining the oil from the turbine and gears to a 350-gallon tank, from which two horizontal duplex oil pumps, 7 inches and 7 inches by 10 inches, pump the oil to the supply tanks.

The engine room auxiliaries include a main condenser of 3,500 square feet cooling surface, a centrifugal circulating pump with 14-inch suction and discharge having a capacity of 5,000 gallons per minute against a head of 15 feet, a twin-beam wet and dry air pump, and the following service pumps:

Pumps

Two main and auxiliary feed, 12 inches and 8 inches by 18 inches, vertical simplex.

One ballast, 12 inches and 10¾ inches by 12 inches, horizontal duplex.

One fire and bilge, 12 inches and 8½ inches by 12 inches, horizontal duplex.

One engine room bilge, 6 inches and 5¾ inches by 6 inches, horizontal duplex.

One sanitary, 7½ inches and 5 inches by 6 inches, horizontal duplex.

One fresh water, 7½ inches and 5 inches by 6 inches, horizontal duplex.

One evaporator feed and ice machine condenser pump, 7½ inches and 5 inches by 6 inches, horizontal duplex.

Two lubricating oil, 7 inches and 7 inches by 10 inches, horizontal duplex.

One lubricating oil cooler, 7 inches and 7 inches by 10 inches, horizontal duplex.

One fuel oil transfer, 7½ inches and 6 inches by 10 inches, horizontal duplex.

Two oil fuel service, 5¼ inches and 3½ inches by 5 inches, horizontal duplex.

One combined air and circulating auxiliary, 10 inches and 12 inches and 12 inches by 12 inches, horizontal duplex.

The engine room equipment also includes a feed heater, capable of heating 35,000 pounds of water per hour from 80 degrees to 212 degrees Fahrenheit when using exhaust steam at 5 pounds gage pressure; a feed water and filter tank of 750 gallons capacity; an evaporator with a capacity of 20 tons in twenty-four hours; a distiller of 2,000 gallons capacity, and an auxiliary condenser with 800 square feet cooling surface.

Boilers

Steam is furnished at 210 pounds per square inch working pressure by three single-end Scotch boilers, 15 feet 6 inches inside diameter by 11 feet 6 inches long. Each boiler has three Morison corrugated furnaces, 45 inches inside diameter, with a separate combustion chamber for each furnace. All of the tubes, except the ten top rows, are 2¾ inches outside diameter. The tubes in the top rows are stay tubes, 4¾ inches outside diameter, and in the two top rows are fitted the superheater units, consisting of U-bends of 1¼-inch tubes, expanded into headers consisting of 7-inch seamless-drawn tubing ½-inch thick.

The boilers are oil-fired and operate under forced draft. The oil burners are of the mechanical atomizing type. The oil is pumped from the double bottom tanks to the settling tanks by a horizontal duplex pump, 7½ inches and 6 inches by 10 inches, and from the settling tanks to the burners by two horizontal duplex pumps, 5¼ inches and 3½ inches by 5 inches.

Other Yards Building Vessels to Same Design

Vessels of this size and of practically the same design are being built to the order of the United States Shipping Board Emergency Fleet Corporation in two other yards. The Carolina Shipbuilding Corporation is building twelve vessels of this type at its yard in Wilmington, N. C., which are fitted with coal-burning watertube boilers with a total heating surface of 9,000 square feet, operating under induced draft and furnishing steam superheated at 50 degrees at a pressure of 200 pounds per square inch to a triple-expansion reciprocating engine of 2,800 indicated horsepower for the propulsion of the vessel. The main engine has cylinders 24½ inches, 41½ inches and 72 inches diameter by 48 inches stroke.

Doullut & Williams are also building eight vessels of this type for the Emergency Fleet Corporation at their yard in New Orleans, La. These vessels are fitted with coal-burning watertube boilers, furnishing steam at 225 pounds per square inch pressure and 75 degrees superheat to a set of Parsons double-reduction geared turbines of 2,800 shaft horsepower, designed to drive the propeller shaft at 90 revolutions per minute.

Bunker Coal for Transatlantic Shipping

Strict regulations govern shipments to the Atlantic seaboard of coal intended for the bunkering of ships. Only the highest grade of coal for steam making is permitted for this service, to the end that each ship shall have a greater steaming radius and higher speed.

Under regulations issued in April, 1918, by Fuel Administrator Garfield, it is prohibited that coal be delivered to any Atlantic or Gulf port for bunkering purposes other than that specified by the Fuel Administration as permissible bunker coal. The shipment of coal smaller than run of mine to any port for bunkering purposes or to any pool designated as a "permissible coal pool" is prohibited, except when special permission is granted by the Fuel Administration. On July 2, 1918, twenty-five additional inspectors were appointed to supervise more thoroughly the preparation of coal for ships.

Orders issued by the Fuel Administration, effective July 23 and July 31, 1918, revised former regulations relative to the required quality and grades of coal for bunkering steamships. The purpose of the orders was to improve the quality and enlarge the quantity of coal for ships in the Atlantic trade.

The removal of the submarine menace to shipping after the signing of the armistice enabled the Fuel Administration, by an order issued on November 25, to make coal supplies available for bunkering purposes from pools Nos. 4 and 10, the use of coal from these pools being prohibited heretofore because its smoke-producing qualities invited attack by U-boats. The addition of these pools enables the more expeditious movement of transatlantic shipping.

HOG ISLAND SHIPS OF 7,500 TONS DEADWEIGHT

Built by the American International Shipbuilding Corporation

Fig. 1.—7,500-Ton Cargo Ship at Fitting-Out Berth, Hog Island, Pa.

Fig. 2.—Portable Tower Crane in Operation at Fitting-Out Berth, Hog Island Yard, 7,500-Ton Vessel Alongside

"Robert Dollar" Type of Cargo Vessel

Designed by Skinner & Eddy Corporation, Seattle, Wash., to Carry 8,800 Tons Deadweight at Sea Speed of 11½ Knots

ONE of the first of the new shipyards in the United States to seize upon the advantages of standardized ship production was the Skinner & Eddy Corporation, Seattle, Wash. This company selected a single-screw cargo vessel of 8,800 tons deadweight carrying capacity, commonly called the *"Robert Dollar"* type from the name of the first vessel built to this design. The principal dimensions of the ship are as follows:

Length overall	423 feet 9 inches
Lloyd's length	410 feet 5½ inches
Beam, molded	54 feet
Depth, molded	29 feet 9 inches
Draft, full load	24 feet 2 inches
Speed on trial	11½ knots
Cubic capacity (grain), about	460,000 cubic feet
Cubic capacity (bales), about	420,000 cubic feet
Deadweight tonnage at load draft	8,800 tons
Coal bunker capacity (permanent), about	700 tons
Coal bunker, reserve, (either coal or cargo)	830 tons
Fresh water capacity, about	200 tons
Fore peak tank, about	120 tons
After peak tank, about	320 tons
Total water ballast (exclusive of fresh water), about	1,460 tons
Gross tonnage, about	5,700 tons
Net tonnage, about	4,400 tons

The vessel is of the forecastle, poop and bridge type, with the machinery amidships, and is rigged with two masts with four 5-ton cargo booms on each mast and two derrick posts each fitted with one 3-ton cargo boom. A 30-ton boom for handling heavy weights is fitted on the foremast.

The forward hold is divided into two compartments by a transverse watertight bulkhead, but no transverse watertight bulkheads are fitted in the after hold. The permanent coal bunkers are just forward of the fireroom and in the 'tween decks around the machinery casing. The bridge house may be used for either cargo or as a reserve coal bunker.

Water ballast is carried in the peak tanks and in the double bottom. The reserve feed and fresh water is carried in the double bottom under the machinery space, while the drinking water is carried in separate tanks in the bridge house.

Cargo is handled through four large and one small cargo hatches through the upper and second decks.

Hull Construction

The double bottom is divided by watertight floors and a watertight centerline keelson into fourteen compartments. Bilge wells are located at each end of the machinery space. In the double bottom the frames and reverse frames are angles, while above the tank the frames are channels spaced 27 inches apart, except in the peaks, where they are spaced 24 inches apart.

All the floors are of solid plate with lightening holes. Two longitudinals are fitted on each side of the center keelson in the double bottom. The margin plates are fitted at right angles to the frames.

Web frames are fitted in the engine room, and, where necessary in both the engine and boiler rooms, strong beams are fitted.

The upper deck beams are channels placed on every frame, and the second deck beams are channels placed on alternate frames. Both the upper and second decks are complete steel decks.

Above the tank top the hull is subdivided by five transverse watertight bulkheads and a non-watertight steel bulkhead forward of the athwartship coal bunker. Between the engine and fire rooms there is a steel screen bulkhead. All of the watertight bulkheads extend to the upper deck.

In the holds, side stringers are fitted and two rows of wide-spaced pillars built up of plates and structural shapes. The inner bottom is ceiled with 3-inch fir under the cargo hatches only. Cargo battens of 6-inch by 2-inch fir, spaced 9 inches, are fitted in the holds and 'tween deck cargo spaces.

Deck Machinery

A spur-geared horizontal-type steam windlass, with two wildcats and two large warping ends, is fitted on the forecastle. At each hatch there are two horizontal-geared steam winches with cylinders 8 inches by 10 inches, each giving a drum duty of about 5,000 tons on a single whip. A steam steering gear of the right- and left-hand type is fitted in the poop, together with a horizontal single-geared warping winch.

Living quarters on the vessel are heated by steam and lighted by electricity supplied by two 15-kilowatt compound-wound multi-polar 110-volt generator sets.

Boilers

Steam is supplied at 210 pounds gage pressure by three single-end Scotch boilers, 14 feet 9 inches inside diameter and 11 feet long. Each boiler has a heating surface of 2,500 square feet and a grate area of 60 square feet. The furnaces are corrugated with an inside diameter of 43¾ inches, each furnace leading to a separate combustion chamber 34 inches deep.

The boilers are coal-fired and operate under forced draft, the uptakes leading to a single stack 8 feet in diameter, extending to a height of 80 feet above the keel.

Propelling Machinery

Propulsion is by a single four-bladed propeller about 16 feet 6 inches diameter, which in this type of vessel may be driven by either a triple-expansion reciprocating engine or a geared turbine. If a reciprocating engine is installed, the cylinders are 25 inches, 42 inches and 72 inches diameter by 48 inches stroke, designed to develop about 2,700 indicated horsepower at a speed of 80 revolutions per minute. The high-pressure and intermediate-pressure cylinders are each fitted with a single piston valve, and the low-pressure cylinder with two piston valves. Balance pistons are fitted on top of the intermediate-pressure and low-pressure valve stems.

The thrust bearing is of the horseshoe type with eight solid collars each 22½ inches diameter and 2 inches thick. The thrust shaft is 14½ inches diameter, the line shafting, in seven sections, 13¾ inches diameter, and the propeller shaft 14¾ inches diameter.

The main condenser is independent with about 3,700 square feet of cooling surface. The main circulating pump is of the double-suction centrifugal type with suction and discharge connections, 14 inches diameter, driven by a single-cylinder engine. The main air pump is of the

"ROBERT DOLLAR" TYPE OF CARGO VESSEL 8,800 TONS DEADWEIGHT

Designed and Built by Skinner & Eddy Corporation, Seattle, Wash.

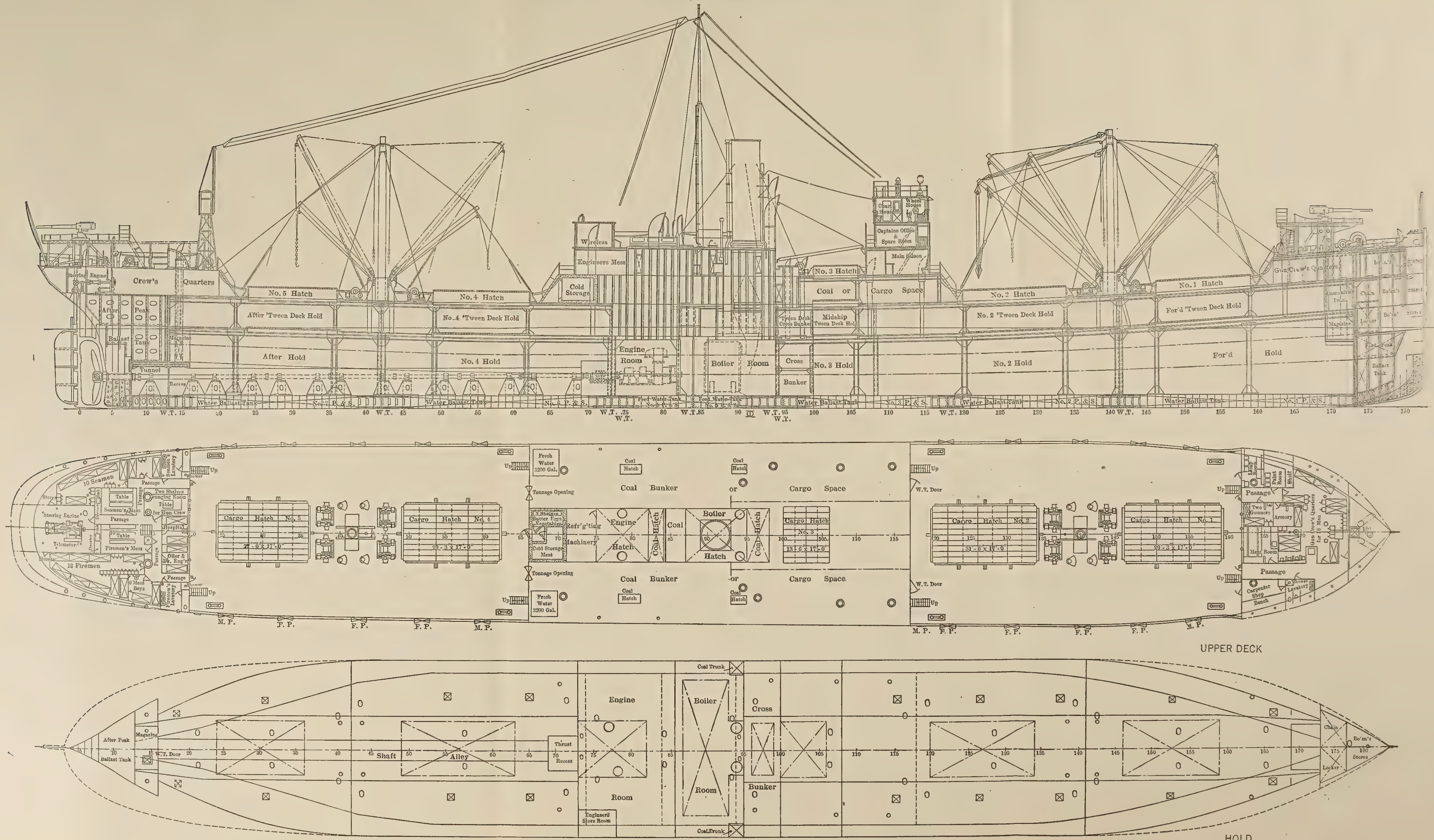


Fig. 1.—Inboard Profile and Deck Plans

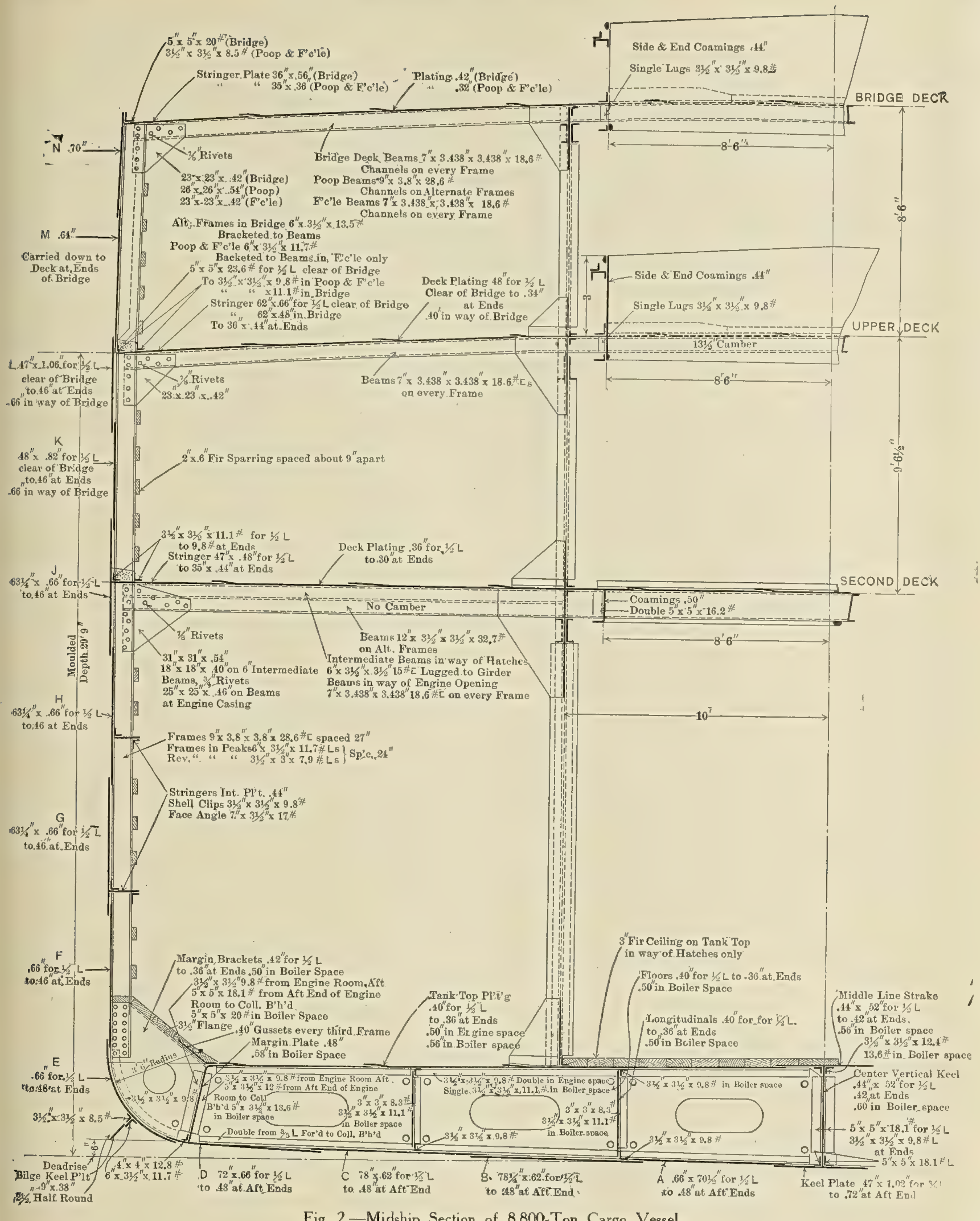


Fig. 2.—Midship Section of 8,800-Ton Cargo Vessel

vertical twinplex type with a steam cylinder 14 inches diameter and two air cylinders each 28 inches diameter by 18 inches stroke. The following pumps are also provided:

Pumps

Two vertical simplex main and auxiliary feed, 12 inches and 8 inches by 18 inches.

One horizontal duplex ballast, 12 inches and 10¼ inches by 12 inches.

One horizontal duplex fire and bilge, 12 inches and 8½ inches by 12 inches.

One horizontal duplex engine room bilge, 6 inches and 5¾ inches by 6 inches.

One horizontal duplex sanitary, 7½ inches and 5 inches by 6 inches.

One horizontal duplex fresh water, 7½ inches and 5 inches by 6 inches.

The engine room auxiliaries include an auxiliary condenser with 950 square feet of cooling surface served by a horizontal combined air and circulating pump, 10 inches by 12 inches by 12 inches by 12 inches; a filter and feed tank containing about 90 cubic feet; a horizontal closed

type feed heater; a 2-inch injector; an evaporator with a daily capacity of 25 tons, and a distiller. The feed heater is designed to heat the water to 220 degrees F.

Turbine Machinery

If geared turbine machinery is installed as the main propelling machinery, the turbine is of the Curtis type of 2,500 shaft horsepower with five ahead stages and two backing stages, both on the same shaft. The turbine drives the propeller shaft at a speed of 90 revolutions per minute through two sets of double helical gearing. With steam at 200 pounds pressure at the throttle and 50 degrees F. superheat with a vacuum of 28 inches in the condenser, the steam consumption is guaranteed at not over 12 pounds per shaft horsepower per hour.

With the turbine machinery the thrust shaft is 13¼ inches diameter, the line shaft 12¾ inches diameter, and the propeller shaft 14 inches diameter. The propeller is of the four-bladed built-up type, 16 feet 6 inches diameter and 13 feet 6 inches pitch.

The main condenser provides 4,000 square feet of cooling surface and two horizontal duplex, 6-inch by 7½-inch by 6-inch pumps are installed for the turbine oil-cooling system.

Standard Sea-Going Cargo Vessel of 3,500-Tons Deadweight Built on the Lakes

Single-Deck Steamer of Maximum Welland Canal Size—Tonnage of Later Vessels Increased to 4,200

In order to pass through the locks of the Welland Canal to reach the seaboard, sea-going vessels built on the Great Lakes are limited to an overall length of about 261 feet. As every effort was made during the war to deliver to the seaboard a maximum amount of tonnage from the Great Lakes, practically every shipyard on the Lakes received orders to build a standard type of vessel of the maximum size that could navigate the Welland Canal. The design adopted called for a single-screw, single-deck type vessel of 3,500 tons deadweight of the following dimensions:

Length overall	261 feet
Length between perpendiculars	251 feet
Beam, molded	43 feet 6 inches
Depth, molded at side to main deck	24 feet 2½ inches
Load draft, about	21 feet
Block coefficient	0.797
Deadweight carrying capacity (not including spare parts or water in boilers)	3,500 tons
Indicated horsepower	1,250
Speed	11 knots

As shown by the plans, the hull has a straight stem and elliptical stern, a complete double bottom and single deck with poop, bridge and forecastle. To aid in camouflaging the vessels during the war, only a single steel mast was fitted amidships, and for handling the cargo derricks two hinged derrick masts were fitted. In ordinary times this type of vessel would be fitted with two steel masts, from which the cargo booms are operated.

Hull Construction

The hull is subdivided by four watertight transverse bulkheads, extending to the main deck into two cargo holds, and a machinery space amidships. Access to the cargo holds is gained by four main hatches served by 4-ton cargo booms, two being provided for each hatch.

In the subdivision of the hull, the forward and after peaks are used for water ballast and trimming tanks. The No. 1 double-bottom tank extends clear across the ship, with a non-watertight center division forming a single tank for water ballast. The No. 2 double-bottom tank has a watertight center division, providing two separate tanks for ballast. No. 3 double-bottom tank has a watertight center division, forming two feed water tanks. No. 4 double-bottom tank is divided by a watertight center division into two ballast tanks, while No. 5 tank has a non-watertight center division, forming a single-ballast tank.

The double bottom extends from the forward collision bulkhead to the after peak. Solid floors are fitted on every third frame, and the entire double bottom is divided by watertight floors into five fore-and-aft compartments.

Outside the double bottom the frames are channels spaced 24 inches apart. In the inner bottom on solid floors the frames are of angles, and on open floors channels. The reverse frames are angles on all solid floors in the double bottom, and channels on open floors. All of the floors under the engine and boiler spaces are solid, with lightening holes. Forward of the machinery space, to three-fifths the length, every third floor is solid between the center keelson and margin, the balance being of bracket construction.

One longitudinal is fitted on each side, intercostal between the solid floors and increased in thickness in the machinery space. The margin is of the diagonal type.

Web frames are fitted in the engine and boiler spaces and forward where required. Side stringers are fitted forward only.

The main deck beams consist of channels fitted to every frame, the camber of the beams being 10½ inches in a length of 43 feet 6 inches.

The four cargo hatches through the main deck are each 18 feet wide by 22 feet long. These hatches are served by eight 4-ton cargo booms, for each of which there is a two-cylinder reversible single-drum winch with cylinders 8¼ inches by 8 inches.

Fresh water for culinary purposes is carried in two fresh water tanks on the bridge deck, with a total capacity of about 6,500 gallons. The bunkers are fitted on each side of the boiler and engine spaces and in the bridge space over the boilers. An emergency bunker is also provided in the after end of the No. 1 hold.

The living spaces in the vessel are heated with steam and lighted by electricity furnished by a 10-kilowatt generator. Provision is made for lighting the cargo holds by portable clusters.

In addition to the foregoing, the deck machinery includes the necessary windlasses and capstans, steam steering gear and an ice machine of 1-ton capacity.

Steam is furnished at a pressure of 180 pounds per square inch by two single-end two-furnace Scotch boilers,

GREAT LAKES STANDARD 3,500-TON CARGO VESSEL

Length Between Perpendiculars, 251 Feet; Beam, Molded, 43 Feet 6 Inches; Depth, Molded, 24 Feet 2½ Inches; Block Coefficient, 0.797

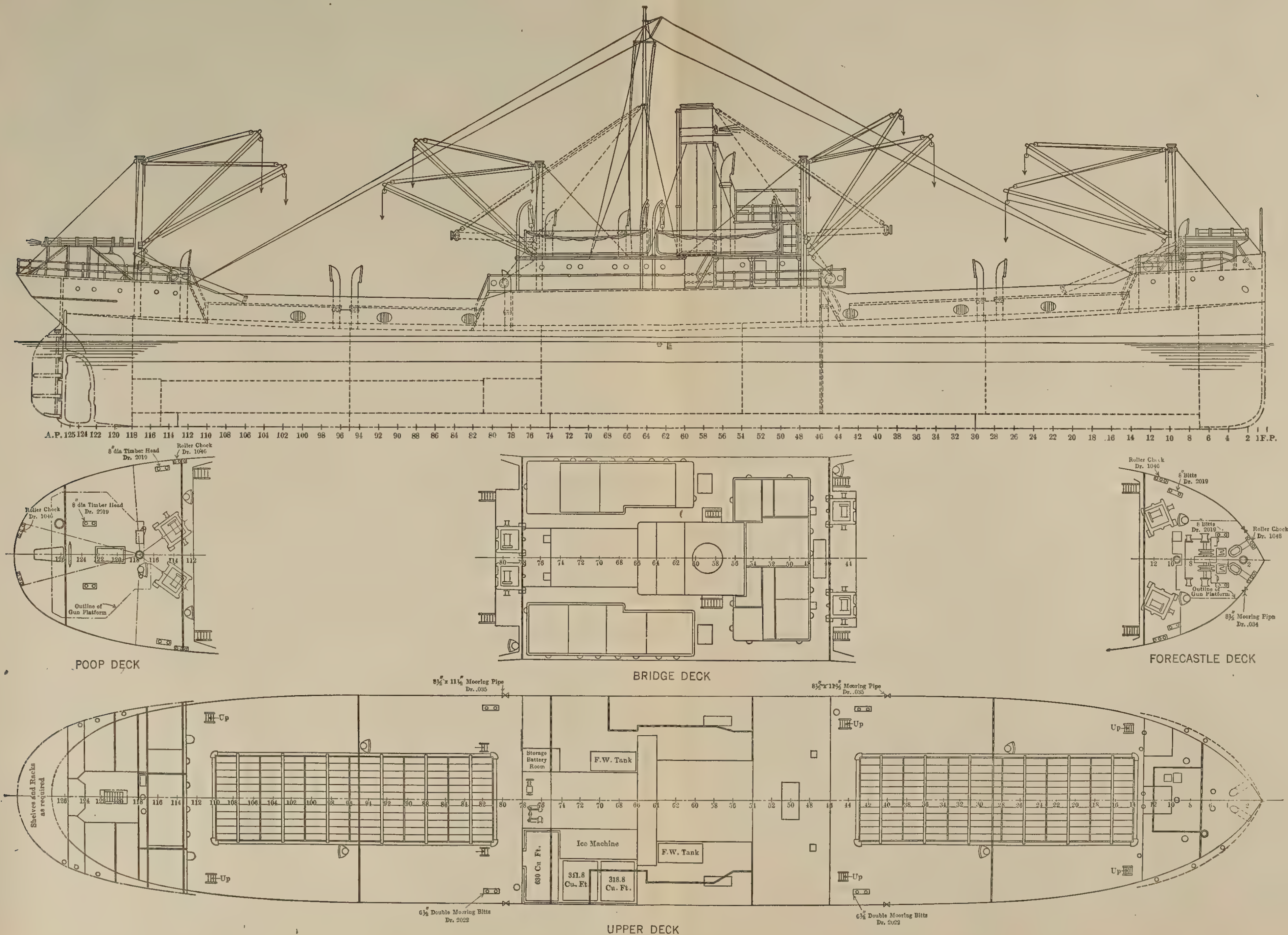


Fig. 1.—Profile and Deck Plans

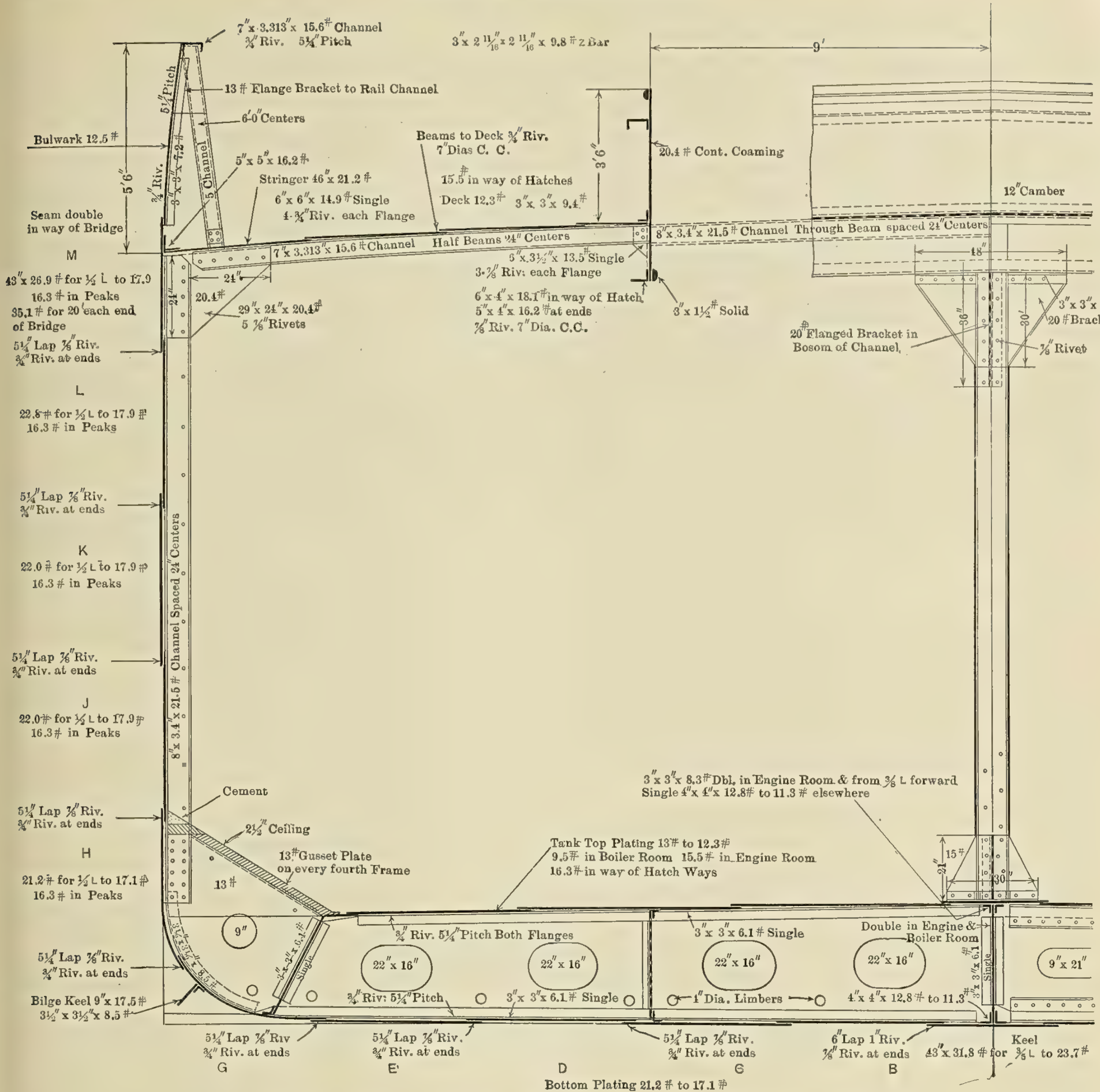


Fig. 2.—Midship Section of Standard 3,500-Ton Cargo Steamer Built on the Great Lakes

13 feet mean diameter by 11 feet length, located in a single fireroom with the grates fore-and-aft and operating under heated forced draft. The boilers have a total heating surface of 3,900 square feet and a total grate area of 88 square feet. Each boiler has two Morison corrugated furnaces 48 inches inside diameter. Separate combustion chambers are provided for each furnace.

Propelling Machinery

Propulsion is by a solid cast iron four-bladed propeller, 13 feet 7½ inches diameter, driven at a speed of 85 revolutions per minute by a double-acting inverted triple-expansion reciprocating engine with cylinders 20 inches, 33 inches and 54 inches diameter by 40 inches stroke, designed to develop 1,250 indicated horsepower. The piston speed of the engine is about 566 feet per minute. The framing of the main engine consists of six cast iron box columns, the cylinders are placed from forward to aft, high pressure, intermediate pressure, low pressure and the

(*Concluded on page* 245)

Economies Expected by Welding Ships

The economies which it is hoped to achieve by welding ships are far from beginning and ending with the saving of time and labor in riveting. It is pointed out that a 10,000-ton ship costing $1,900,000 (£400,000) now costs but $83,000 (£17,500) to rivet, and that if electric welding only promises to modify this amount, no very substantial gain will be obtained. Many other benefits will, it is hoped, follow the change from riveting to welding, and tests have in view the abolition or at least the lessening of the transportation from the rolling mill to the fabricating plant when the latter is not at the shipyard; the template makers' work; the markers' work; the punching, and much of the work of the fitters and bolters who flog and pull the pieces so as to make them fit when on the ways. It is estimated that, taking into consideration all the above items, a saving of one month in the time of construction and of no less than $38 (£8) a ton in the cost of the steel structure may be made, the total saving in cost being $97,500 (£20,000) on a 10,000-ton vessel.

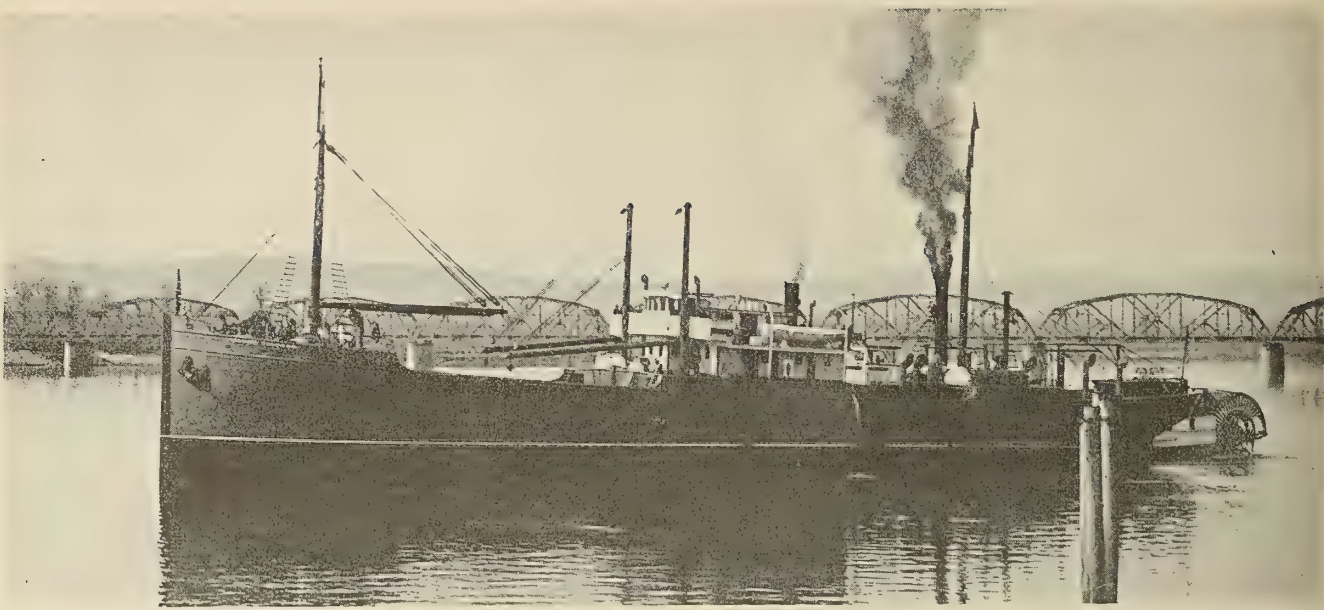


Fig. 1.—Twin-Screw Wooden Motorship *James Timpson*

American Diesel-Engined Motorship

Gear-Reduction Transmission Applied to Twin-Screw Wooden Freighter Equipped with Moderately High-Speed Diesel Engines

AMONG the new features which have been introduced in the propulsion of vessels very recently, mechanical reduction gears have played an important part in the equipment of slow-speed steamships fitted with high-speed turbines. For the first time this idea has been applied in a similar manner to the power plant of a Diesel-engined motorship where the engines are of moderately high speed and the service of the vessel that of an ordinary tramp.

The vessel in which this installation was made is the twin-screw wooden motorship *James Timpson,* designed by Cox & Stevens, naval architects, New York, for I. T. Williams & Sons, New York, and built by the Standifer Construction Company, Vancouver, Wash. The vessel has a deadweight carrying capacity of about 3,000 tons on a load draft of 23 feet. Its length overall is 280 feet and between perpendiculars 268 feet, with a beam of 46 feet and depth of 22 feet.

Propulsion is by twin screws driven by 6-cylinder, single-acting, direct-reversible, four-cycle Winton Diesel-type engines, built by the Winton Engine Company, Cleveland, Ohio, operating through mechanical gear-reduction transmission. The engines have cylinders 12 15/16 inches diameter by 18 inches stroke and are rated at 500 brake horsepower, making the total power of the vessel 1,000 brake horsepower. The reduction gears are of the Falk double-helical type, with both gears floating and built with a ratio of 3 to 1, supplied by the Falk Company, Milwaukee, Wis. With a full cargo, the vessel maintains an average cruising speed of 8.78 knots.

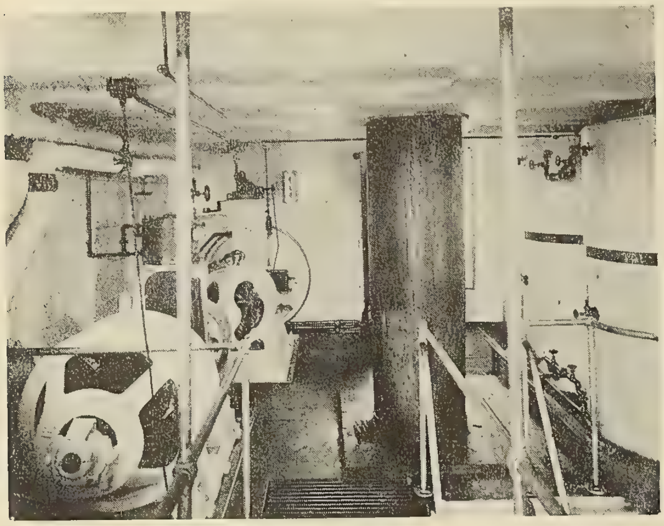


Fig. 2.—Auxiliary Steam-Driven Generator in Foreground; Main Generator Operated by 15-Horsepower Oil Engine in Background

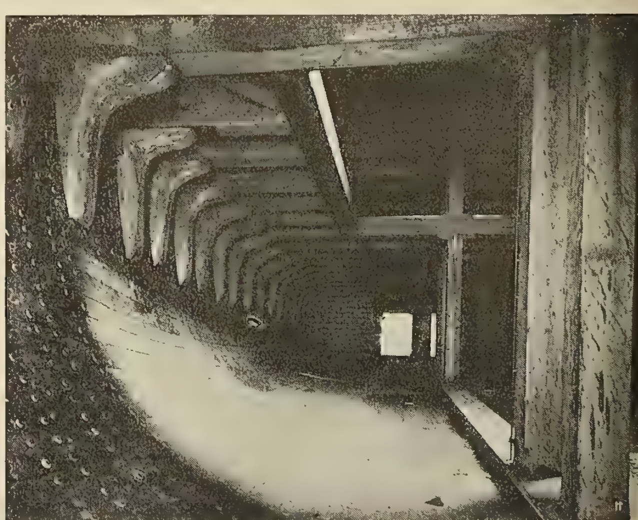


Fig. 3.—View in the Hold Showing Type of Hull Construction, Stanchions and Deck Beam Knees

The auxiliaries consist of an oil-burning donkey boiler supplying steam for the operation of an auxiliary air compressor, an auxiliary 12-kilowatt electric generator, bilge pumps and deck winches, and also for heating the vessel. The main lighting unit consists of a 10-kilowatt generator, driven by a 15-horsepower oil engine. Steering is by means of a Herzog electrical steering gear operated by a 1½ brake horsepower electric motor connected to a reduction gear attached to the rudder stock.

Chief Engineer Charles K. Wirosteck, in a recent report, stated that the ship had logged a trifle over 14,500 miles, and that during that time he had experienced no trouble with the main power plant or with the reduction gears; the only serious trouble developing was from the donkey steam boiler, which gave more or less trouble throughout the various trips; in fact, it was necessary to make practically a new installation of this equipment recently, and a new system of fuel injection and burning for the steam boiler was installed, so that better efficiency from this part of the power plant is now to be expected.

Beyond the fact that this boat is equipped with all-American Diesel engines, it is also equipped with reduction gears, one of the first American Diesel motorships to be so equipped. The gears were built by Falk, of Milwaukee, and are on a 3-to-1 ratio with both sets of gears floated. Cut from solid chunks of chrome nickel steel, of the double-helical type, these gears have run 14,500 miles to date without giving a moment's trouble, without overheating once, and to-day they do not show any wear. In fact, it is hard to believe they have been in service at all. The use of these reduction gears makes it possible to install a much more compact and lighter power plant. The engines operate at from 265 to 300 revolutions per minute, and the propellers at 75 to 85 revolutions per minute. The propellers are 9 feet 8 inches by 11 feet, four-bladed.

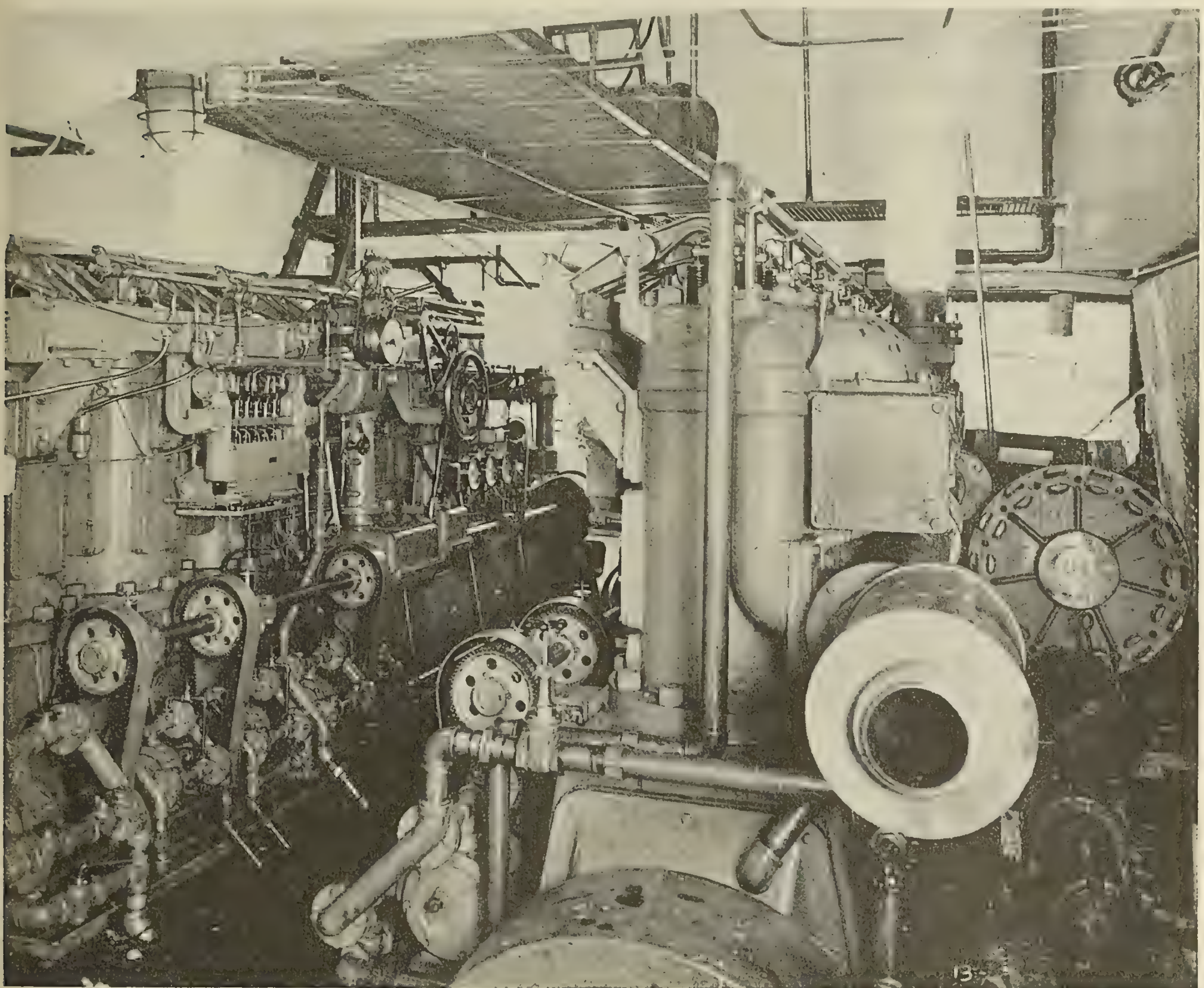


Fig. 4.—Engine Room. Main Engines Are of Winton 6-Cylinder Diesel Type, of 500 Brake-Horsepower Each, Driving the Propellers Through 3 to 1 Falk Double Helical Reduction Gears

Unfortunately, a complete record of fuel consumption is not available, as the fuel oil is carried in main storage tanks, from which the main power plant, the donkey boiler and the generating set obtain their fuel, and it is impossible to figure the consumption of each unit separately. The log shows, however, that from the time the boat left her yard at Vancouver, Wash., until she arrived in New York city, she took aboard 2,200 barrels of fuel oil, during which time her main engines were in operation 1,650 hours, the total distance logged being a trifle over 14,500 knots. Consequently, her daily fuel consumption for all units of the power plant averaged between four and five tons (28 to 35 barrels) with the engines operating at

Fig. 5.—Bow View of M. S. *James Timpson*

Fig. 7.—Main Deck, Looking Forward

continuous full load. This represents 3,000 tons of cargo carried on an average of 1.35 barrels of fuel oil per hour for a 24-hour day.

The ports called at were:

1.	Vancouver	Levinton, Ore.
2.	Levinton, Ore.	Marshfield, Ore.
3.	Marshfield, Ore.	San Francisco, Cal.
4.	San Francisco, Cal.	Bay Point, Cal.
5.	Bay Point, Cal.	San Francisco, Cal.
6.	San Francisco, Cal.	Eureka, Cal.
7.	Eureka, Cal.	San Francisco, Cal.
8.	San Francisco, Cal.	Panama, Canal Zone
9.	Panama, Canal Zone	Majellones, Chili
10.	Mejellones, Chili	Iquique, Chili
11.	Iquique, Chili	Caleta Buena, Chili
12.	Caleta Buena, Chili	Panama, Canal Zone
13.	Panama, Canal Zone	Colon, Canal Zone
14.	Colon, Canal Zone	Baltimore, Md.
15.	Baltimore, Md.	Norfolk, Va.
16.	Norfolk, Va.	New York City
17.	New York City	Gulfport, Miss.

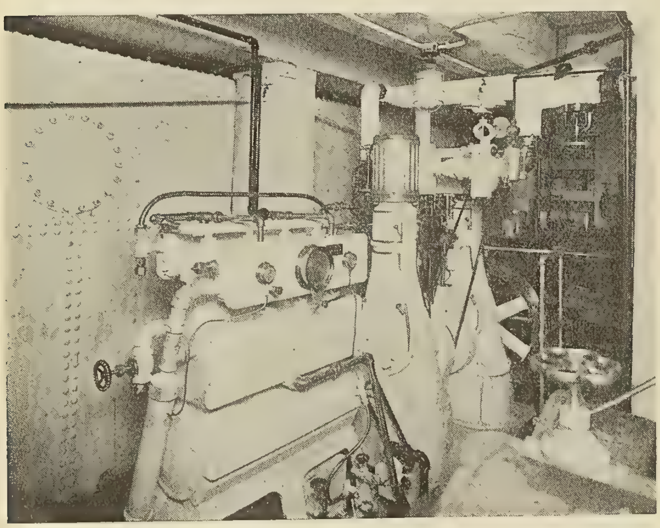


Fig. 6.—Winton Auxiliary Air Compressor Operated by Steam Engine

The lubrication oil consumption averaged about 14 gallons per day of 24 hours for both engines.

The steering of the *James Timpson* is taken care of by a Herzog electrical steering unit operated by a 1½-horsepower electric motor connected to the rudder stock by a reduction gear. It is operated by a small lever on the bridge deck in connection with a magnet. In approximately 20 seconds the vessel can be thrown from hard a-port to hard a-starboard.

It is interesting to compare the crew of the *James Timpson* with the crew of a steam-driven ship of the same approximate size and cargo capacity—approximately 3,000 tons:

Crew of the *James Timpson*	Crew of a 300-Foot Steamship—Coal-Burning
Captain	Captain
First mate	First mate
Second mate	Second mate
Third mate	Third mate
Chief engineer	Chief engineer
Three assistant engineers	Three assistant engineers
Three wipers	Three oilers
Two donkey boiler men	Six firemen
Wireless operator	Six coal passers
Boson	Wireless operator
Carpenter	Boson
Six sailors	Carpenter
Cook and three helpers	Six sailors
	Cook and five helpers
26 in all as a maximum	38 in all as a maximum

Other interesting comparisons can be found in the difference in space occupied by the compact, light-weight Winton Diesel engines and the large, slow-turning steam engines; or the difference between the space occupied by

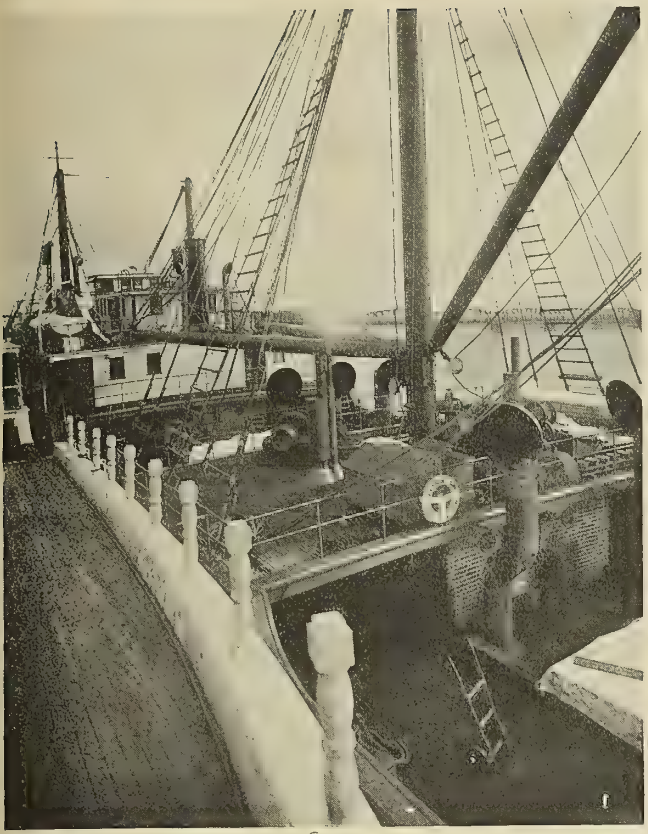


Fig. 8.—Deck Houses, Amidships

Fig. 10.—Main Deck, Looking Aft

the fuel oil in the *James Timpson* and the coal in the other type of ship; or the difference in time taken to take aboard fuel oil through a pipe or the slow process of coaling; or the fact that the *James Timpson* can take aboard enough fuel to go to Europe and back without re-fueling and still have enough oil on board to go back again, and the fact that her oil tanks are located in places which cannot be used for cargo space, thus giving another item of economy to an already long list. Hence the advantage gained in a vessel of the *James Timpson* type may be summed up briefly as maximum cargo capacity, minimum crew, quick fuel loading, hence no delays at port, highly efficient and economical power plant.

Note.—After this article had been written, the following telegram was received from Charles K. Wirosteck, chief engineer of the *James Timpson*, which recently left New York city for Gulfport, Miss.:

Editor of Marine Engineering:

"New record made with *James Timpson*. Run New York to Gulfport averaged 9¾ knots at 265 revolutions of engines. Ship light. Head wind two days, heavy sea. Made trip New York to Gulfport in 9 days 8 hours. Engines first class."

(Signed) Charles K. Wirosteck.

This adds further emphasis to the fact that, despite this boat being powered with comparatively high-speed Diesel engines, and, in addition to this, being equipped with reduction gears, it has given excellent proof of its dependability and high efficiency.

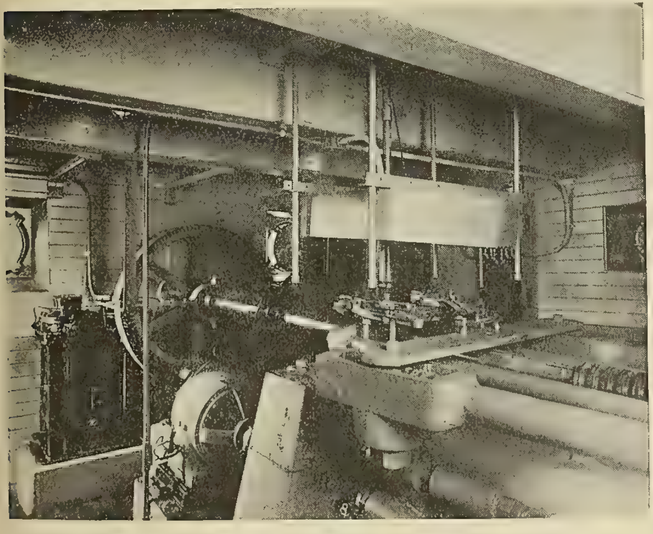


Fig. 9.—Herzog Electrical Steering Gear. Electric Motor Connected to Rudder Stack by Reduction Gear

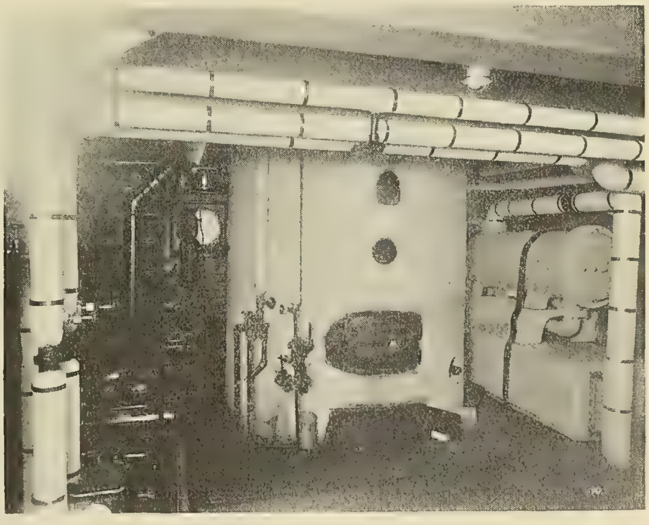


Fig. 11.—Oil-Fired Donkey Boiler with Condenser on Right and Bilge Pumps, etc., on Left

Some Aspects of Large Diesel Cargo Ships

Steam and Diesel Machinery Installations Compared—Better Economy, Higher Speed and Greater Operating Radius for Diesel Ship of Same Displacement

BY H. R. SETZ*

OUR newly created fleet of cargo ships is to-day facing the task of entering the commercial field in competition against those nations who for years have been the carriers of the world's overseas commerce. In consequence of a natural course of development, as dictated by their increasing experience, these nations have established standards of practice which we shall have at least to equal, and, owing to our particular conditions, indeed, exceed, if we are successfully to meet this foreign competition.

The requirements imposed by this dictum are not the same which brought our cargo ships into existence. Under the pressure of the war emergency the principal requirement was rapidity of production, to which every other consideration had to be subordinated. To-day the principal consideration has become one of economy in the widest sense of the term; this imperatively demands substantial recognition of factors which, justly or unjustly, were passed by during the war period.

Diesel Engines Make for Economy in Operation

By far the most important single factor making for economy in the operation of cargo vessels to-day is the Diesel engine. This is being proven conclusively in the increasing number of large foreign Diesel ships now regularly plying to our shores, the clock-like regularity of their trips incidentally bearing evidence of their technical success as well.

The writer has recently had occasion to make a comparative study of the installation of a certain type of large Diesel engine in place of the steam equipment now actually used, and proposed for possible future use, on the 9,600 tons deadweight standard cargo boat of a prominent Atlantic coast yard. The results are of sufficient interest to justify publication of some of the most outstanding facts; being taken from actual practice, they clearly illustrate the possibilities of Diesel engines on large cargo ships.

Details of Steam Equipment

Figs. 3 and 4 show the layout of the equipment now used, consisting in its main units of three oil-fired Scotch boilers, each 15 feet 6 inches diameter by 12 feet long, one steam turbine developing 2,500 shaft horsepower at 3,600 revolutions per minute, and a double reduction gear driving the propeller shaft at 90 revolutions per minute. As indicated on the layout, the auxiliary equipment is very complete, duplicate sets being provided to ensure continuity of operation, such as auxiliary condenser, lubricating oil pumps, generating sets, etc.

The weight of this equipment complete, including boiler uptakes, stack and induced draft system, circulating pumps and all the small auxiliaries shown, amounts to 550 tons. The engine and boiler rooms are located amidships, covering a space extending about 50 feet in length. This, it will be noticed, does not include any deep tanks to carry boiler feed water or fuel oil. Under normal operating condition, the vessel traveling at its fully loaded sea speed of 11 knots, the fuel consumption of this installation, including auxiliaries, runs in the neighborhood of 30 tons per 24 hours.

Figs. 5 and 6 show the power plant layout for the same vessel driven by a triple-expansion steam engine instead of the turbine reduction gear set, the experiences had with the latter giving sufficient cause for anxiety to suggest such a change as a future possibility. The boiler end of the installation remains the same, whereas the engine room auxiliaries change somewhat in conformity with the particular features of the main engine. The complete

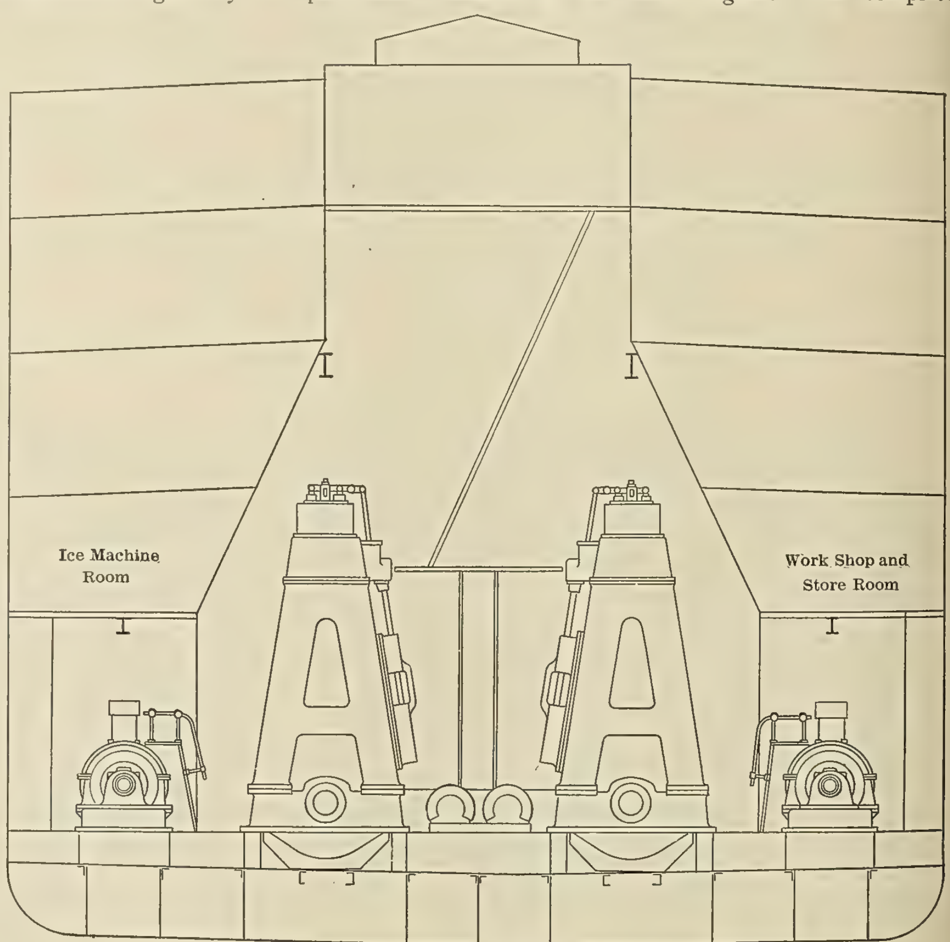


Fig. 1.—Section Through Engine Room of 9,600-Ton Motorship

* Consulting engineer, New York.

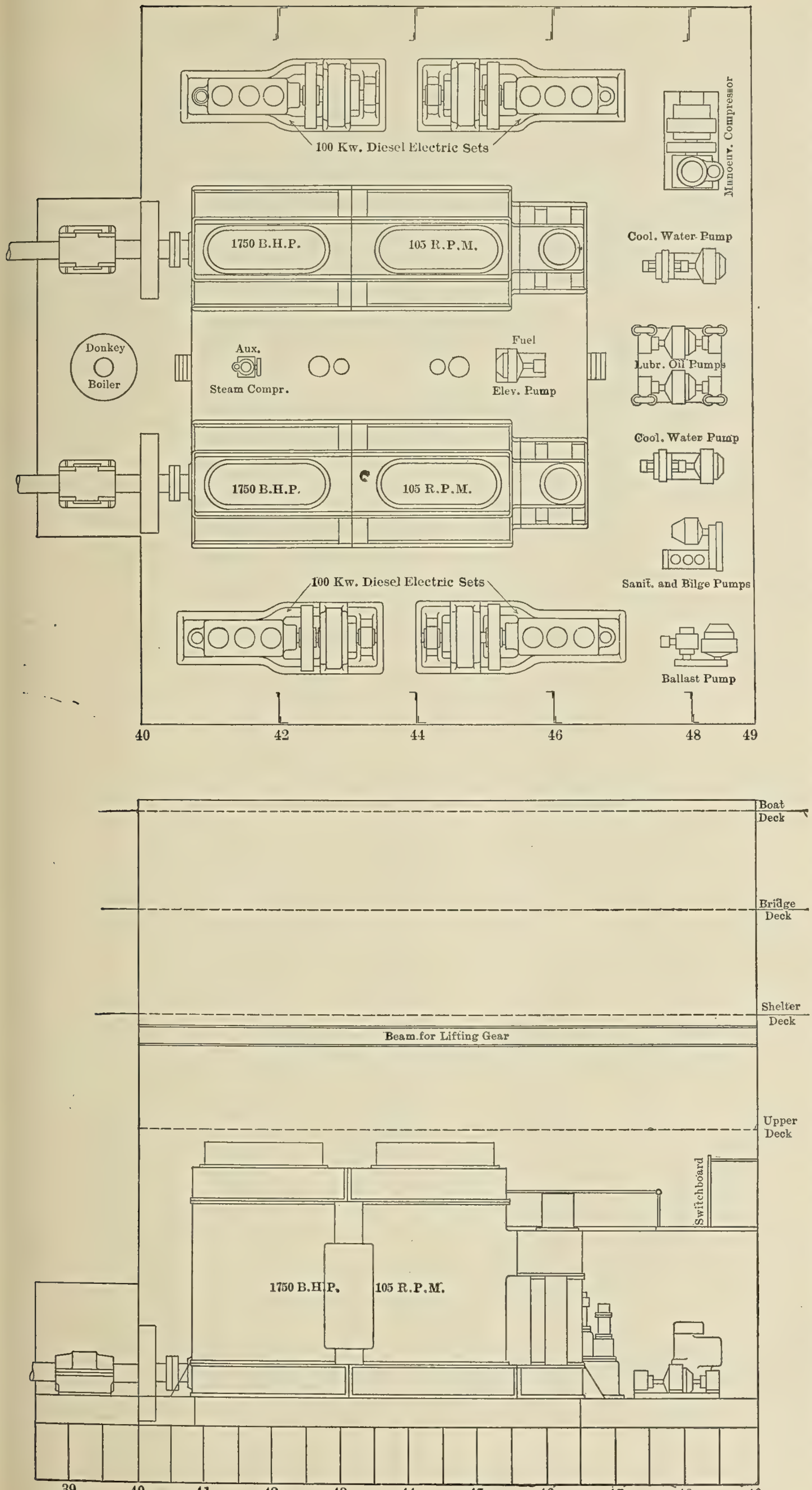


Fig. 2.—Plan and Elevation of Engine Room, 9,600-Ton Motorship

equipment, however, will go in the same space as the geared turbine set, while the weight will increase to 610 tons. The fuel consumption of this installation would hardly be less than 35 tons per 24 hours.

Attention is called to the fact that the fuel consumptions given for the turbine or triple-expansion engine respectively are those corresponding to the best possible operating conditions of the whole installation. The average results obtained on a long voyage are likely to be higher, owing to the variable contingencies of operation (weather, load, plant conditions, etc.), all of which make the maintenance of an even and high economy, even of an oil-fired steam plant, difficult and demand close personal attention. In other words, the personal element enters so decidedly into the economy question, and is such a variable quantity, that the figures given above are merely representative of what is within possible reach but is likely to be exceeded.

Corresponding Diesel Installation

Figs. 1 and 2 show the layout of the proposed Diesel engine installation. This, in accordance with the most approved modern practice, consists of two main units, each driving its propeller at a speed of 105 revolutions per minute. Owing to commercial considerations it would be desirable to increase the speed of this vessel from its 11 knots under steam power to at least 12 knots, if within the limits of Diesel engines. The Diesel engines, therefore, will have to develop 1,750 shaft horsepower each, which is considerably below the power that to-day is the largest practical output of engines of this type.

This combined capacity of 3,500 shaft horsepower

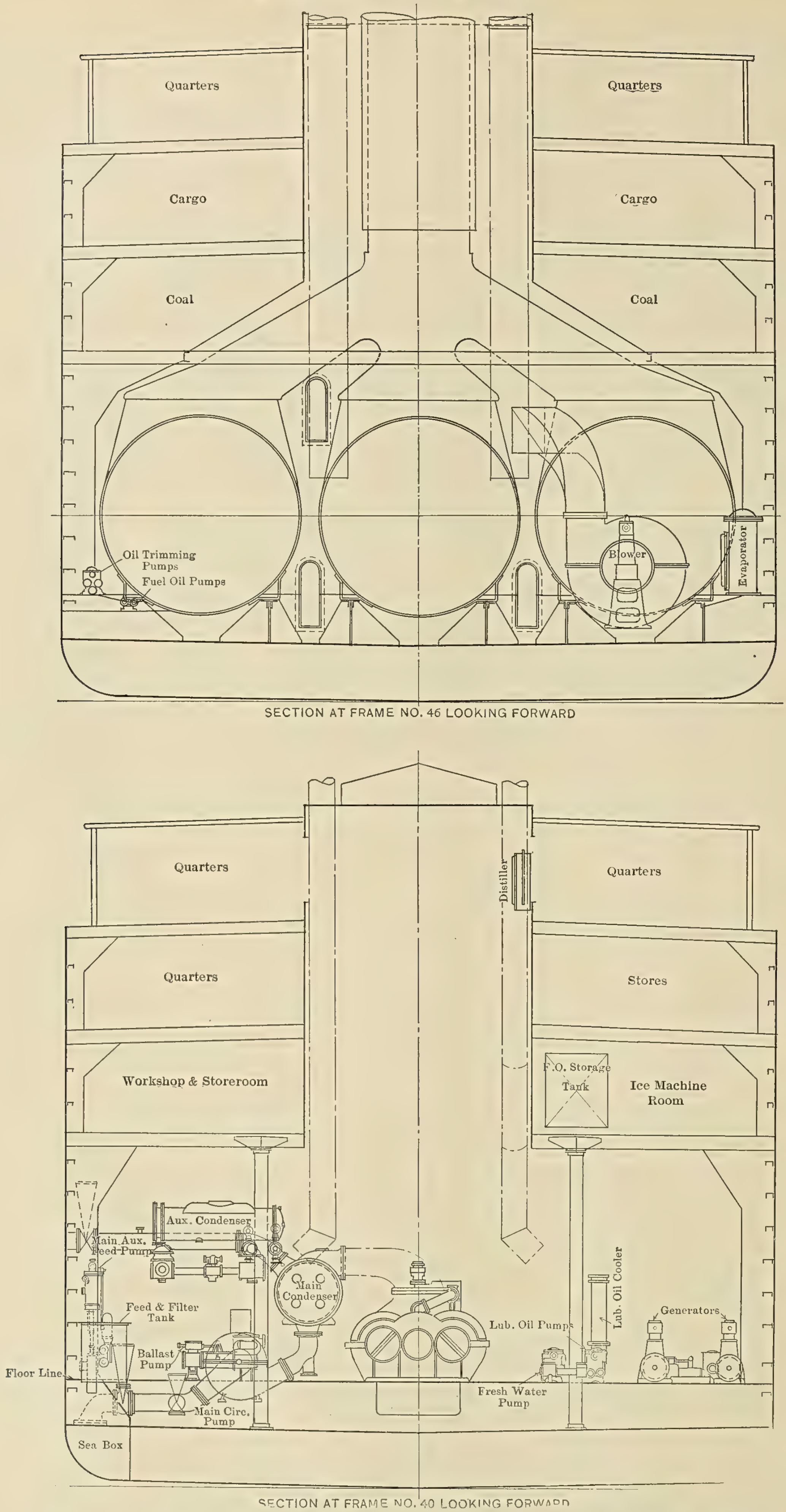


Fig. 3.—Sections Through Boiler and Engine Rooms of 9,600-Ton Turbine-Driven Cargo Steamer

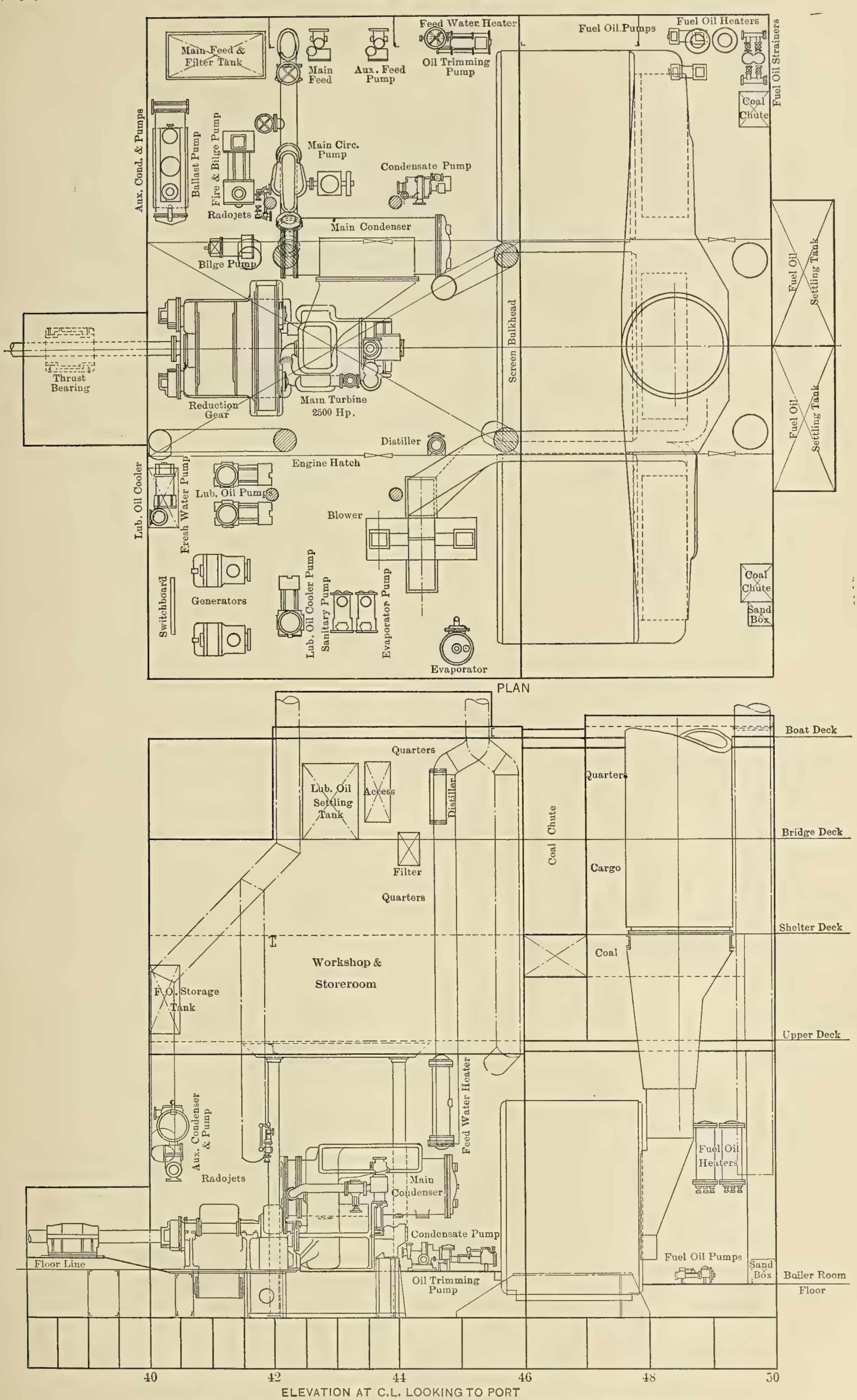


Fig. 4.—Machinery Arrangement of 9,600-Ton Turbine-Driven Cargo Steamer

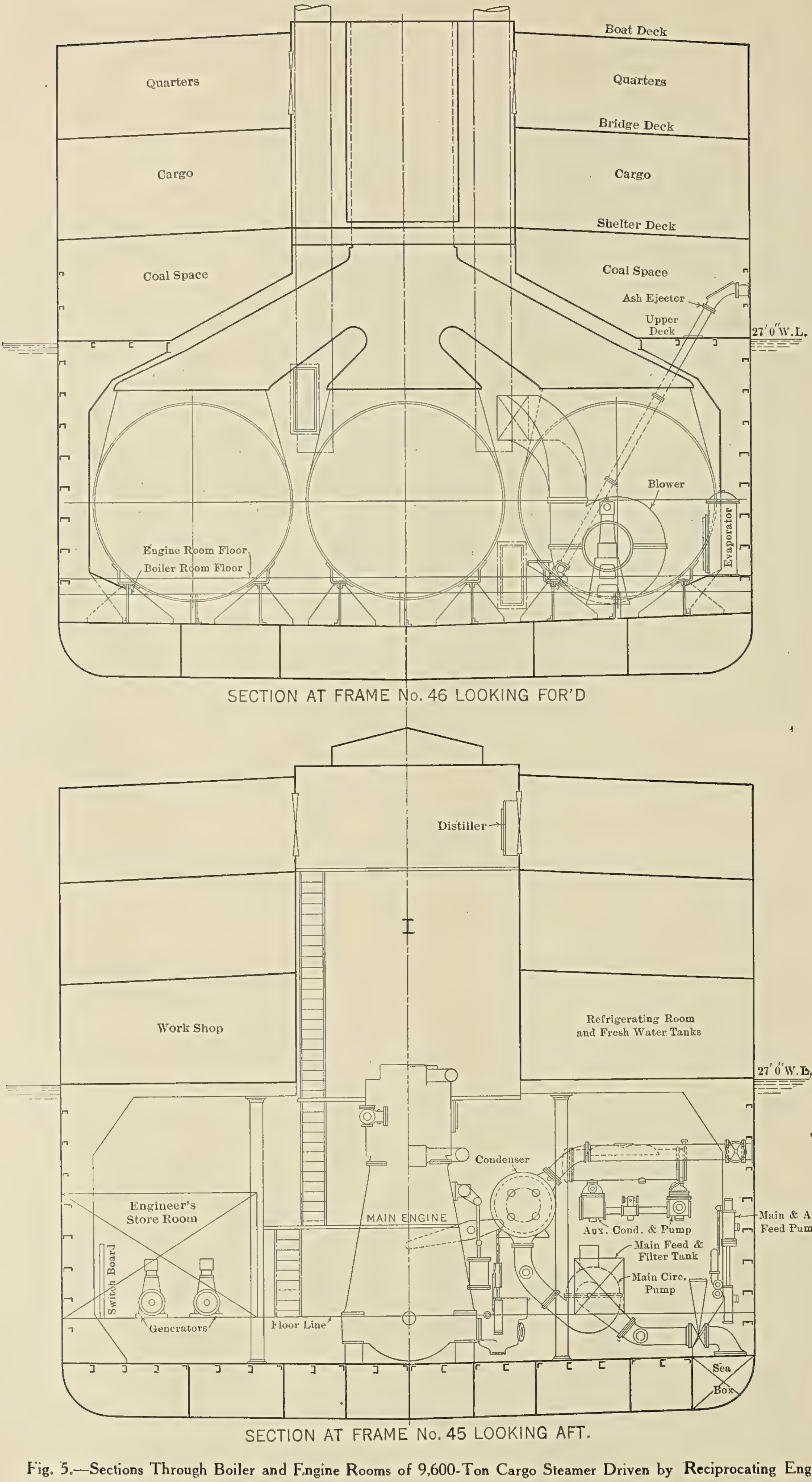


Fig. 5.—Sections Through Boiler and Engine Rooms of 9,600-Ton Cargo Steamer Driven by Reciprocating Engine

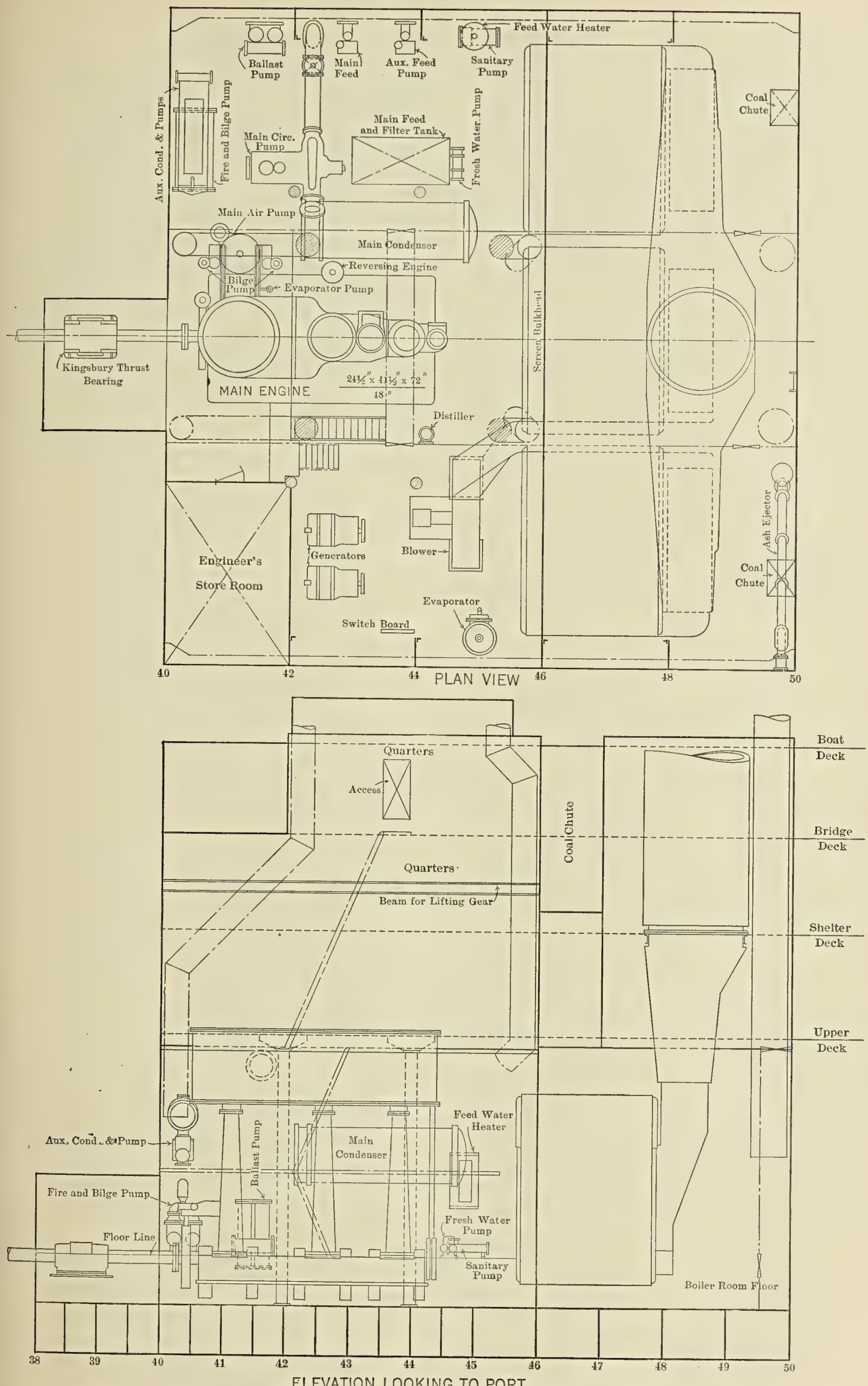


Fig. 6.—Machinery Arrangement for 9,600-Ton Cargo Steamer Driven by Reciprocating Engine

is somewhat in excess of the ideal requirements, 3,150 shaft horsepower, and therefore easily ensures the maintenance of 12 knots sea speed even under most unfavorable service conditions, especially since these engines have the usual overload margin.

Outside of the two main engines, the equipment consists of four 100-kilowatt, 3-cylinder Diesel electric sets running at 300 revolutions per minute each. This rather liberal supply of auxiliary power is provided so as to be able to make use of electrically driven auxiliaries throughout the ship, including the cargo hoists, windlass and steering gear, i. e., all the deck machinery, as well as the auxiliaries required in the engine room.

The auxiliaries in the engine room consist of a double set of lubricating oil circulating pumps, of whch two are always driven by one motor, two centrifugal cooling water pumps, one sanitary and bilge pump, one ballast pump and one fuel elevating pump. The motors required for these pumps vary in capacity from 5 to 25 horsepower. There is, furthermore, provided a two-stage maneuvering compressor driven by a 60-horsepower motor. The uniformity and simplicity of this auxiliary equipment is worth noting in comparison with the diversified apparatus that goes with a steam installation.

An oil-fired donkey boiler of about 100 square feet heating surface, located in the thrust recess between the two main engines, supplies steam for heating purposes and to the small auxiliary steam compressor. Between the main engines are located the injection air receivers, while the two main starting air tanks, kept charged under 300 pounds pressure, are located forward of the storeroom, immediately under the upper deck. It may be mentioned that, owing to the method of starting incorporated in this particular engine, the use of starting air is extremely economical, requiring less than half the usual air receiver capacity; for this reason the maneuvering air compressor can also be made considerably smaller than is customary.

The exhaust from the main and auxiliary engines will be run in separate pipes up the after engine room bulkhead to suitable silencers located in a small silencer house on the boat deck; this leaves only short runs of straight piping in the engine room, which by liberal water cooling and lagging can be insulated to prevent excessive heat radiation, thus obviating the necessity of special fans. The very effective air circulation caused by the suction of the engines, of course, further aids in keeping the engine room temperature down.

Weight of Diesel Equipment

The weight of the two main engines complete with all necessary piping and air receivers is 420 tons. The auxiliaries complete as shown will weigh from 150 to 160 tons, making the maximum weight of the complete installation 580 tons, or 370 pounds per main engine shaft horsepower, as compared to 490 pounds of the steam turbine reduction gear installation and 545 pounds with a triple-expansion engine.

In spite of the 1,000 horsepower additional capacity of the Diesel installation, as compared with the steam equipment, the compactness of the former is striking. Without in the least crowding the various units together, it is possible to locate the main engines and all auxiliaries in an engine room only 45 feet long overall. The gain in cargo space thus effected amounts to 8,200 cubic feet, or equivalent to slightly over 2 percent cargo ton capacity. (Steam equipment to the same aggregate capacity as the main Diesel engine could not be installed in a space less than 70 feet long, reducing the cubic capacity of the boat by over 30,000 cubic feet. To this should be added an increase in weight of machinery amounting to 30 to 35 percent over the figures given above.) This remarkable compactness of the Diesel engine, more or less a feature of all makes now in successful use, is particularly pronounced with the type under consideration, owing to its careful design and admirable simplicity and directness of application of the most advanced principles of marine engine construction.

Fuel Consumption

Under regular service conditions, with the boat fully loaded and traveling at a speed of 12 knots, the fuel consumption of the main engines (including auxiliaries) will not exceed 15½ tons per 24-hour day. With a storage capacity in the double bottoms, all of which is used for carrying fuel oil, except a lubricating oil tank of some 10 tons capacity, close to 1,100 tons, this will permit the ship easily to operate at its normal speed for a period of 65 days, allowing about 100 tons of fuel as stand-by for emergencies and reserve for loading and unloading while in ports away from a favorable fuel supply. The loading and unloading operations, together with other power required while in port, will consume not over ¾ ton of fuel per day.

Comparing this with the steam equipments, making the same proportionate allowance for a reserve supply, although the fuel consumed while in port will easily amount to 3 tons per day, the available fuel will be sufficient for just 30 days' traveling with the turbine-driven boat, and 26 days when using the triple-expansion steam engine. Reduced to steaming radius, owing to the difference in speed between the two vessels, the turbine steamer will be able to cover 42 percent and the reciprocating engine driven ship barely 37 percent of the distance possible with the Diesel ship, in spite of the latter's higher speed, which necessitates using 40 percent more power than the steamers.

The steamship owner thus faces the alternative of having to operate over shorter and rather selected routes, so as to permit of more frequent refuelling, or else to carry an additional fuel supply in the hold at the expense of valuable cargo space. In the cases in question, in order to equal the performance of the Diesel boat, the extra weight carried would have to be not less than 1,250 tons in the turbine ship and 1,400 tons with the triple-expansion engine, which is equivalent to 13 and 14½ percent respectively of the total capacity of the vessel.

Account should next be taken of the supply of fresh boiler feed water, which with either type of steamer amounts to not less than 150 tons, whereas for the donkey boiler of the Diesel ship 35 tons is sufficient; the difference of 115 tons may, however, be considered equalized by the extra shaft tunnel and the tunnel tank of the Diesel ship.

Allowance should furthermore be made for the smaller engine room crew required by the Diesel ship, which, even if it should not materially reduce the payroll, means at least smaller quarters and less supplies, and therefore a corresponding increase in cargo space.

Summary of Advantages Gained in Diesel Ship

Summarizing, we thus find that the displacement of the respective boats being the same, the complete machinery of the Diesel ship weighs approximately the same, although its speed is 9 percent greater than that of the steamers. With the same tonnage of cargo and initial fuel supply, the Diesel ship will have a 240 percent greater operating radius than the turbine boat and 270 percent greater radius than the reciprocating engine driven boat. Conversely, for the same radius of operation, the steamers could carry only 87 percent and 85½ percent respectively of the cargo which the Diesel ship can handle, to which should be added the increased revenue capacity of

the latter resulting from the greater distance which its higher speed permits it to cover in one year's operation.

These pronounced superior advantages in fuel economy, cargo weight and space capacity and radius of operation result in returns which, applied on a common percentage basis, are equivalent to the interest of a much larger capital than that invested in a steamer of the same displacement. Under existing market conditions for material and labor, this permits the valuation of a motorship to be set from 20 to 22 percent higher than that of the steamer after allowance for the higher cost of the Diesel equipment has been made. This figure is, of course, subject to improvement as the rate of production of Diesel ships increases, but even as it is it shows a way to absorb quite a material percentage of the higher cost of production of our ships as compared to that of foreign-built vessels. Moreover, owing to the use of a smaller engine room crew, as well as owing to the maintenance of a uniformly high economy independent of the personal element, which is a typical feature of Diesel engines, their installation on American cargo ships will bring the cost of operation more nearly to the same level as that of our foreign competitors.

These are features which should be taken advantage of to the fullest possible extent in order to bring into existence an American merchant fleet of real economic capacity. The use of Diesel engines on large cargo ships is to be particularly invited. Outside of the comparatively short voyages to Europe, the principal lanes of travel of our merchant fleet will be the much longer distances down the east coast of South America and especially to the Orient, where China and Siberia alone are potential markets far more important for the United States than all the others combined. These are countries comparatively far removed from natural supplies of oil, and to negotiate these long voyages economically it is imperative that our vessels be propelled by machinery which does not require inconvenient stops or extra trips for refuelling. The Diesel engine is singularly well adapted for these particular routes, and its adoption is the *one* move whereby an American merchant marine can assert itself.

This is as important a consideration to shipowners as to shipbuilders. Now is the time, as long as our merchant fleet is still in the formative stage, to catch up with and exceed the pace already set by users and builders of motorships in Europe.

Based upon the foregoing figures, and assuming a mileage for the average round trip to the Orient of 14,000 nautical miles, the savings effected by the lower fuel consumption and corresponding increase in cargo-carrying capacity, as well as by the higher sea speed of the Diesel ship, arrange themselves as follows:

	Diesel Ship	Steamer Turbine	Steamer Engine
Duration average round trip, days....	49	54	54
Days in port..........................	24	24	24
Number of round trips per year......	5	4.6	4.6
Fuel consumption per round trip, including days in port, tons........	780	1,620	1,890
Excess fuel consumption over Diesel ship, tons		840	1,110
Excess fuel cost over Diesel ship, fuel at $16.50 per ton................		$13,860	$18,315
Decreased cargo revenue compared to Diesel ship, cargo ton at $15....		$18,900	$24,975
Total discrepancy per year..........		$150,700	$199,100
Additional revenue of Diesel ship, owing to higher speed, equivalent to 7,500 tons more cargo carried per year	$107,900		
Excess annual earnings of Diesel ship over steamers	$258,600 (over turbine ship) $307,000 (over reciprocating engined ship)		

In the above figures the difference in other operating items such as wages and food for the engine room crew, lubricating oil, etc., are not included; aside from being relatively insignificant compared to the tabulated figures, a saving in one direction with Diesel engines (smaller engine room crew) is offset by a saving in the other direction with the steam plant (lower lubricating oil consumption), the relative differences of these items, while slightly in favor of the Diesel engine, not being of sufficient importance to be worth considering here. The important point is to focus attention on the tabulated items, and particularly on the substantial gain in revenue capacity of the Diesel ship due to its higher speed, which adds 54 and 71 percent respectively to the increased earnings resulting from the lower fuel consumption. This gain is particularly significant if it is remembered that the complete Diesel equipment with which this higher speed is attained can be installed in a smaller space than that of either steam plant; the resulting gain in cargo space, which with cargo classified by cubic measurement for its tonnage will amount to another substantial increase in revenue, is not even included in the tabulated figures.

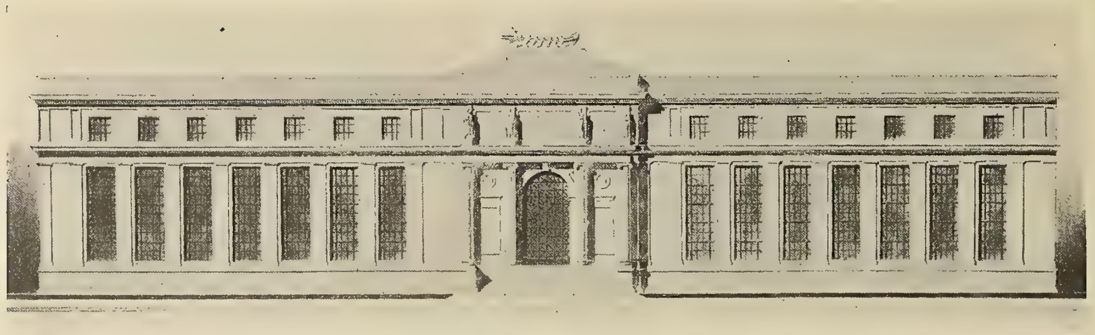
The exposition just issued by the Department of Operations of the United States Shipping Board regarding future shipbuilding invites careful contemplation upon this feature of space and weight requirement of the propelling machinery, since some of the new types of ships are recommended to be driven by quadruple expansion steam engines at a sea speed of 13 knots. Outside of technical objections which give rise to some doubt as to the advisability of using such engines in this particular application, their bulk and weight, in addition to the great quantity of fuel these boats will have to carry for the specified steaming radius even in spite of their improved economy (about on a par with that given above for the turbine), will impose enormous commercial disadvantages.

Compared to a twin-screw Diesel installation of similar combined capacity, these disadvantages are so pronounced that it would be little short of a calamity to undertake construction of such steamers on an appreciable scale at so late a date. Even if such action should suggest itself by the possibility of production on a somewhat quickened schedule, this advantage is of so momentary a nature that it fades into insignificance in relation to the broad issue of bringing into existence an economical American merchant marine. From the viewpoint of national expediency, the early and unprejudiced recognition of the Diesel engine in the various forms in which it has proved to be feasible is the only path open whereby to reach our goal.

Fortified with a mass of valuable experiences which extend back over almost ten years of practical marine work, we are to-day in a position to build Diesel engines without any question as to their technical success. Problems pertaining to design and construction are so well understood that it is easily within the capacity of properly informed specialists to meet almost any requirement. What we need now is actually to embark upon the application of this accumulated knowledge in American shops, under conditions which are conducive to the same concentration and continuity of development that has led to the high stage of perfection in Europe. This is a perfectly natural process of evolution which involves no secrets, but likewise permits no short cuts.

Considering the sizes of engines that will be needed, however, and the expense involved in their development, it cannot be reasonably expected that the few private enterprises which by location, equipment and organization could to-day do such work justice take the initiative without some tangible encouragement. It is up to the Shipping Board to inaugurate such activity, and that on a comprehensive plan which will ensure a healthy develop-

(*Concluded on page* 250.)



Architect's Drawing of the Pratt School of Naval Architecture

Pratt School of Naval Architecture

Work of the Department of Naval Architecture and Marine Engineering at the Massachusetts Institute of Technology

BY PROFESSOR C. H. PEABODY*

IN 1893 the Massachusetts Institute of Technology, Boston, Mass., offered a course of instruction in naval architecture and marine engineering, graduating the first class in 1895. The number graduated from that regular course with the degree of Bachelor of Science has reached a total of 222. In 1900 the United States Navy Department selected the Institute to give a special course to officers designated for the Corps of Naval Constructors; seventy-eight constructors have been graduated with the degree of Master of Science. Upon the declaration of a state of war in 1917, a short course in naval architecture for technical graduates, and teaching only naval architecture and ship design, was offered. Three other such short courses have been given, with a total membership of eighty-five. Such, in brief, has been the service of the Department to the nation, and, in large part, toward the prosecution of the great war.

There is a certain inevitable resemblance of all technical schools and colleges wherever located in America or in foreign lands, and especially of all courses in naval architecture; there must be certain fundamental preparation in mathematics and natural service, and certain subjects of instruction and methods of construction and design must be presented. There is a tendency at present to offer at technical schools a variety of courses of engineering; some are well known, such as civil, mechanical and electrical engineering, others are newer or more special, like sanitary engineering or gas engine engineering; but all are primarily engineering and are likely to show marked divergencies only in the later years of the course. Naval architecture harks back to the time of wooden ships, when the ship carpenter was brother to the house carpenter; but now the shipbuilder is an engineer with affiliations with the bridge builder and the boiler maker, and must work in conjunction with the marine engineer. In consequence of this condition, the first two years of the course in naval architecture and marine engineering at the Massachusetts Institute of Technology are scarcely differentiated from general engineering; in the second year of the course, instruction is given in ship construction and in ship drafting, in order that students may have the advantage of working in a small department where they become well known personally and to enable them to use their summers advantageously.

Vacation Work in the Shipyards

For many years the Institute has had a general understanding with the shipyards of the Atlantic Coast by virtue of which students in the vacations following the sophomore and junior years work in either the yard or the engine shop, or in both. All students desiring such work have had opportunity, and most have taken advantage of it. Though a naval architect cannot know too

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View of the Massachusetts Institute of Technology from the Charles River Embankment

much of the details of ship construction or operation, the chief advantage of such an experience is that the student becomes familiar with the conditions of shipbuilding and can better appreciate both theoretical instruction and practical design and construction. He learns to think in terms of ships. Again, he works with the men who build the ships and learns to understand human nature.

As the third and fourth years progress, the student gives more attention to the theory of naval architecture, including the methods of computing displacement and stability, the study of waves and the rolling of ships, and also of the devices for controlling the rolling, the determination of power required for propulsion and of methods of applying the power, and, finally, the consideration of the stresses likely to be set up in the structure of the ship when at sea. Each student makes a design of a ship in sufficient detail to insure that he learns the methods of construction and arrangement and all the usual computations of displacement, stability and strength; computations for launchings are also made.

Model Making

Each student makes a model of the hull of his ship, on which he lays out the plating and from which he prepares an order sheet. Incidentally, he gains an idea of form and learns to interpret his ship lines. The Department has a well-equipped wood-working shop with saws and planes for preparing materials for models, so that the students' work can be precise and expeditious.

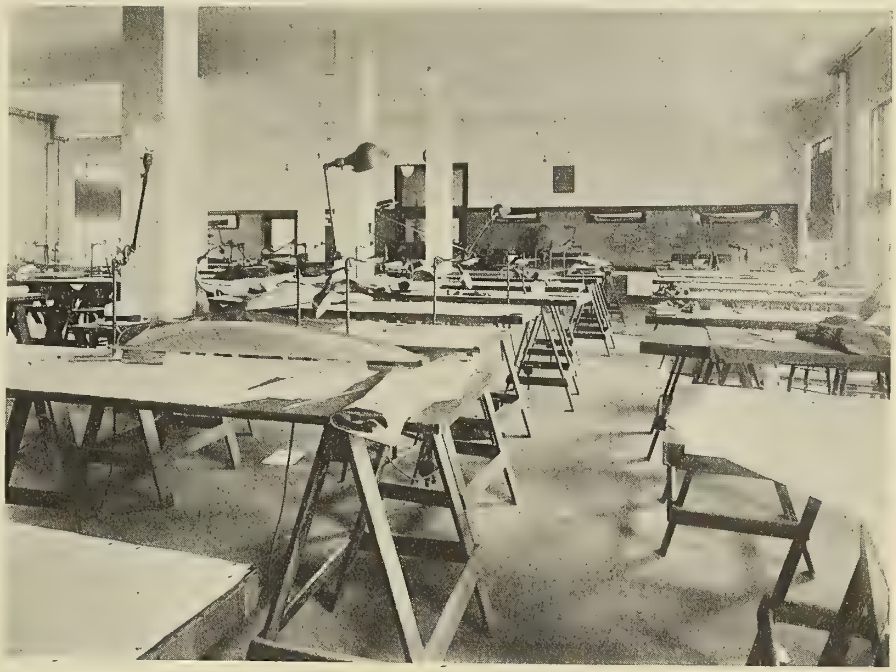
The Department has a set of glass-topped tables for fairing lines to a large scale and has been in the habit of giving instruction in mold loft work at the end of the junior year. This provides a means for the practical application of the theoretical knowledge gained in the class rooms.

Little has been said as yet about marine engineering, which can be separated only with difficulty from naval architecture. In practice, the engines and their arrangement and the propellers are cared for by the marine engineer; but the student must treat the subject of propellers in connection with propulsion, which has much to do with the determination of the forms of the ships. Formal instruction in marine engines, including steam turbines, is given in the senior year, at which time the student makes a preliminary design of the engine and its arrangement and considers the probable stresses in the frame and moving parts as affected by steam pressure and dynamic action. So much concession is made to custom as to make the drawing of the propeller a part of marine engineering, even though the design is made in connection with naval architecture.

Since the naval architect must provide a location for the compass and should understand conditions required to avoid undesirable deviations, the Department has a standard compass and binnacle and a pelorus, which are used to teach compass adjustment.

Naval Constructor's Course

As already said, officers designated for the corps of naval constructors, after graduating from Annapolis and a year or two of sea experience, are selected for scholastic ability and general character and come to Technology for a three-year course, covering the junior and senior years and a graduate year; on graduation, they receive the degree of Master of Science. The instruction in theoretical naval architecture is the same as that of the regular course, but with more time at command they have longer and more detailed training in ship design and construction commensurate with the difficulty of meeting the demands that a warship shall combine great gun-power, speed and protection with the least possible displacement. The course, like the regular course, includes marine engines and turbines and also electrical engineering, aeronautical engineering and methods of accounting. Considering the maturity of the officers, the methods of selection and their zeal in their profession, it is fair to say that few candidates for the master's degree come with so high a standard of ability and achievement.



Drafting Room in the Department of Naval Architecture

Speed and Economy Trials of Vessels

The favorable location of Technology enables students to visit ships, shipyards and engine works in connection with their studies. Many speed and economy tests of ships of various importance have been made by students of the Institute in preparation of their graduation theses. Notable among them were the tests of the Coast Guard ship *Manning* and the destroyer *Sterret*. The course in naval construction just described is restricted to officers of the Navy, but a parallel course giving substantially the equivalent is maintained which is open to all students, whether they are Americans or citizens of other countries.

In 1915, the Institute offered a graduate course in aeronautical engineering leading to the degree of Master of Science, attached to the Department of Naval Architecture. From this course there are ten graduates, of whom five were detailed from the Signal Corps of the Army.

Aeronautical Engineering

A four-foot wind tunnel, modeled after one in the National Physical Laboratory at South Kensington, was installed when the course opened; it is expected that a seven

foot tunnel will be built in the near future. Our tunnel has been under contract to the Army since the declaration of war with the central powers. Immediately after that declaration, two ground schools of aviation were established at the Institute—one for the Army on May 21, 1917, and the other for the Navy on July 23, 1917. In connection with the latter there was established a school for airplane inspectors October 1, 1917. The Institute has perhaps made its most notable contribution to aeronautical engineering by carrying through two classes of officers of the Army and Navy who had already become pilots. The first class numbered thirty beginning March, 1918, and ending September, 1918; the second class began September 30 and ended January 25, 1919, numbering fifty-six. Officers having adequate training in engineering were selected for these classes.

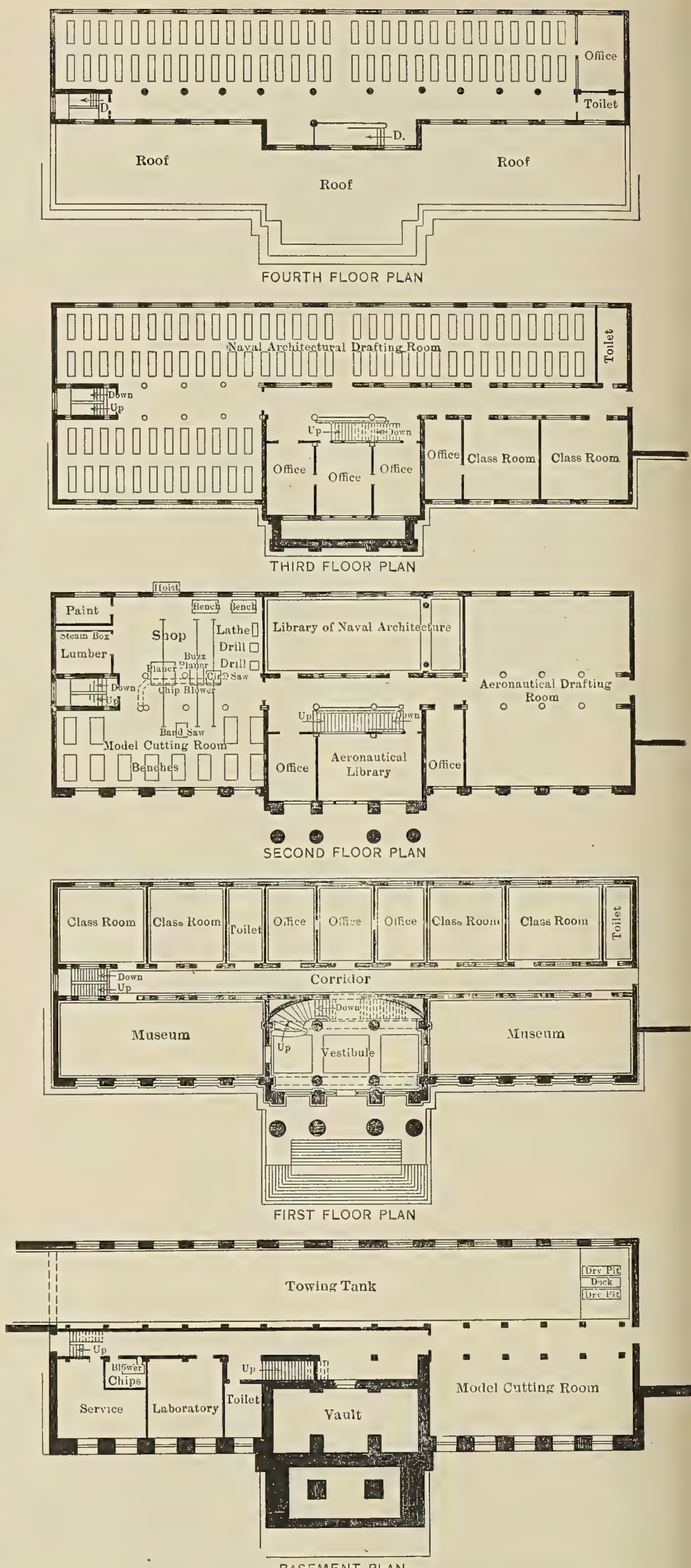
However legitimate and desirable may be the association of aeronautical engineering with naval architecture, this is hardly the place for a detailed description of our course. It is likely that an undergraduate course will be offered soon.

Fortunately, the regular service of the Department of Naval Architecture has not been interrupted by the war, though somewhat dislocated; thus the senior class of 1917 was graduated in April, while the class of 1919 was graduated in September, 1918; but next year the Department will be on its normal peace footing and able to care for all who come.

The Pratt School of Naval Architecture

In 1912, Mr. C. H. Pratt, of Boston, left his estate to the Institute, with the proviso that there should be erected a memorial building to his father and himself, to be known as the Pratt School of Naval Architecture and Marine Engineering, and that the remainder of the estate should be used as a permanent endowment of the Department. At the present time the estate is in the hands of the Corporation of the Institute and is valued at a million dollars. This benefaction ensures an adequate course in naval architecture and marine engineering at Technology, and also a course in aeronautical engineering in connection therewith.

Some years elapsed before the Institute could complete all legal requirements and obtain full control of the Pratt fund, and then the war delayed building because the priority commission could not grant permission for the requisite material. Now plans are ready and there will be no further delay in the erection of a suitable memorial building. This building will face on Massachusetts avenue adjoining the wing of the main building on that avenue. It will be 180 feet long, three stories high, on the avenue to conform with the general plan of the



Plans of the New Pratt School of Naval Architecture

Technology buildings; it will have four stories at the rear, the fourth story not showing above the parapet on the street.

In the Pratt building there will be adequate accommodation for the Department of Naval Architecture and Marine Engineering, including the course in naval construction and the course in aeronautical engineering, with provision for normal development. There will be large well-lighted drawing rooms, many lecture rooms and necessary offices. There will be a convenient room for cutting ship models equipped with proper machines. This shop can be used also for making aeronautical models for the wind tunnels. The tunnels themselves will be accommodated in another building.

Provision is made for two museums, one of naval architecture and one of aeronautics, to preserve notable material and to give examples of construction.

The question of providing a tank or model basin is yet under advisement; provision can be made for housing the inner end of the tank and all its appurtenances in the Pratt building, but the great length required for the tunnel would carry it through the next building and beyond, the next building belonging as yet to the future. Of course the tank, if so located, could be completed without waiting for the erection of a future building that might easily be erected over it. The plans of the Pratt building are shown on these pages. These plans will be followed substantially as given, with perhaps minor changes.

The Education and Training of a Naval Architect

Courses Designed to Give Broad Outlook Upon the Whole Field—College Curriculum Combined with Practical Work—Development of Designing Originality

BY LAWRENCE B. CHAPMAN*

The present revival in shipbuilding in this country, together with the fact that keen competition will exist in shipbuilding and shipping among the nations, will create a demand for men rigorously trained in naval architecture. During the last few years the American merchant marine had sunk to the nadir of its existence, and, as the demand for men technically trained in naval architecture has been small, the proper attention has not been given to the education of men in this field. The men which the technical schools have produced in the past are not of the type that the future will demand. It is for this reason that I am prompted to place my studies and views before the engineering public.

Efficient Operation Will Eliminate Handicap

The course of training that I shall present is rather a departure from the accepted courses as given in this country. We should bear in mind, however, that this country is just entering the field of maritime commerce, in which other nations are well established. At the outset we are hampered by labor conditions and seamen's laws that put us at a disadvantage with our competitors. For us to compete successfully with them under these conditions, it is necessary that we design more efficient ships and build and operate them in a more efficient manner. Moreover, due to the greater difficulty of accomplishing improvements in the field of naval architecture to-day, as compared with the last century, the future will call for higher ability than has been exercised in the past. The men who are to carry out this work must be trained in the broadest and most rigid manner.

It is assumed in this article that the student is training for a professional status in naval architecture. Some of the men who complete the course will eventually drift into allied fields, and others will give up the career of a naval architect for one in some other branch of engineering. This fact, however, is given no weight in the following discussion.

* Associate member of the Institution of Naval Architects.

The first essential requirement for a course of training in naval architecture, as well as in any branch of engineering, is that only those who have the proper aptitude should be encouraged to pursue it. The student should show by his boyhood activities and interests that he has a natural bent for the calling; he should have a clear conception of the nature of the duties that one in this line will be called upon to perform; and he should be fitted by ability and mental caliber for the work required in the engineering profession. In short, he should feel that he is claimed by the field of naval architecture and not choose the work blindly or in a haphazard manner.

Many times the qualifications which make the man fitted for the work are almost impossible to determine or analyze; at least, their discovery requires much searching study and sympathetic guidance. The present method of choosing a vocation in an offhand manner in high school and then entering college directly, or, what is even worse, of entering the technical school direct from high school and choosing a course of naval architecture during the first or second year at haphazard from among other engineering courses offered, is absolutely wrong and will seldom meet the above requirements. Too often the parent and instructor do not have a clear idea, and the student a false idea, of naval architecture.

It is evident that this first requirement is very difficult to fulfill faithfully; yet it is one of basic importance. In fact, it is the great problem that every young man, largely ignorant of his own capacities and without inward guidance towards his vocation, is called upon to face. A discussion of this point is beyond the scope of this article. Might not the universities or the Society for the Promotion of Engineering Education reach out into the high schools and guide the student? Associations, environment and the vocation of the boy's father are bound to have important weight in molding the boy for a future in naval architecture.

Later I shall discuss a system of training in which the student spends a year at practical work before entering

college. By following this scheme the student acquires a wonderful insight into the requirements and duties of the profession he proposes to follow, as well as a knowledge of his own temperament and bent. It is one of the best methods possible of solving this difficult yet basic problem.

The second requirement for a training in naval architecture is that the course should be so laid out that a man will obtain a well-rounded education and broad outlook to fit him for the duties of a naval architect, shipbuilder or ship operator. The training should cover the fundamentals of science and engineering, naval architecture, the design and construction of ships, the essentials of heat engineering and marine engines; a study of the management of the shipbuilding industry, and the operation and maintenance of ships.

These subjects should be considered not only from the technical standpoint, but also from the practical and economical standpoint and the point of view of the business man. Such topics as initial cost, overhead expenses, cost of operation of ships, size of ship and earning capacity, types of machinery to install in a given vessel for a given trade, time required in port for unloading, etc., are all problems that the naval architect should be able to handle. The naval architect of the future will find these questions of equal, if not more, importance than the more strictly technical problems of his profession.

Broad Outlook Upon Ship Operation Problems

The whole course of training should be measured, not by the knowledge gained, but the insight into the underlying principles and the ability to give the proper weight to the theoretical, practical and economic consideration of any problem. The man must not acquire technical skill alone, but the ability to control enterprises and to decide in particular cases whether the undertaking is actually worth while or not.

He should be able to grasp the whole problem, financial and economical, as well as technical. To design a ship that is technically correct in all details is one thing; to design an efficient ship when financial and economic conditions are taken into consideration is quite another proposition. Graduates in naval architecture in the past have too often felt it their duty solely to carry out the technical work in naval architecture. To fulfill the demands of the future, naval architects must be more than this; they must be leaders in the shipbuilding and shipping fields as well as technically trained men. They must create, not copy; originate, not accept.

In order that the student may master the essentials in the whole field of naval architecture, he must be in close touch with the practice and management of shipbuilding and ship operation from the very beginning of his training, as well as be pursuing the customary course of study in college. It must be borne in mind that the student is preparing himself to earn a living in a world of business, and the sooner he learns its demands the sooner he will meet with success in his profession.

Practical Work in the Industry

To attain this end, practical work in the industry, by co-operation between the school and the shipbuilding plants and steamship lines, should be a feature of the course of training. The existing college courses of naval architecture in this country do not demand this practical training, and in this respect I believe that they are weak. Practice is a complement to theory, and the two cannot be separated in a course of training.

A number of ways are open to obtain this practical part of the training. One scheme, which is followed almost universally in Great Britain, is to require several years of outside practice before entering the technical school. The apprentice system, in which nearly all the men eminent in naval architecture in Great Britain to-day obtained their training, is a most excellent plan, but could not be put into operation unless the shipyards co-operated to the fullest extent. The aptitude of the boy for the work would also have to be given the most careful consideration early in life. By this plan the boys are apprenticed to a shipyard, generally a government dockyard, at about fifteen. They attend a yard school several afternoons a week, where careful attention is given to their education. After from four to six years of apprenticeship, the best qualified boys enter the technical school for the usual four-years' course. The achievement of the men educated in this manner, among whom were such men as Sir William White and Sir Nathaniel Barnaby, certainly indicates that the system has considerable merit. As far as I know, the plan is not followed in engineering education in America.

The well-known Cincinnati plan of two weeks in the industry followed by two weeks in school is another solution. The English "sandwich system" of a year in school alternated by a year in practical work is of the same character. Both have been criticised because the classroom work is too often broken up and serious interruptions are introduced into the curriculum.

A third scheme is that of requiring practical work during the summer vacations. This system is already in use in some of the schools in this country. From my own studies, I believe that a combination of the first and last schemes, requiring one year of practical work before entering college, followed by three summers of work in the yard and at sea, would accomplish the best results. This would give the student an insight into the profession and a tangible interest in the school work at the very start. It would either spur him on to better work in college or show him before it is too late that his real interests do not lie in the field of naval architecture.

It is very essential that all this practical work be directed by the college faculty, and thorough co-operation, as in the Cincinnati plan, exist between the school and shipbuilding and shipping industries. Otherwise the time of the student will be more or less wasted and the desired results will not be accomplished.

With the proper directing and planning of the high school work, the high school course could be shortened so that the year of practical work need not necessarily lengthen the educational period. This, however, is not always possible or advisable, and in such cases an extra year would be required. The student who puts in an additional year in this manner, however, should be further advanced at graduation than the student who has not, and, in the final analysis, the period of training will probably be shortened.

It is extremely important that the boy be guided in this year between high school and college, otherwise the time will be practically wasted. Care should be taken to see that his habits of study are not broken up, by prescribing a course of study and reading. I concede that the accomplishment of this plan requires earnest consideration and is not as simple as the mere statement might indicate.

The requirements in practical work should include experience in shipyards and shops where methods of construction and handling material can be observed, and experience in the drawing and designing offices where plans and technical calculations are made and materials ordered. Some time, also, should be put in in the shipyard offices, where there is an atmosphere of business. Finally, a short time should be spent on shipboard, where the han-

dling of ships and their machinery can be studied. This part of the training will also give the student an opportunity to observe the action of a ship at sea, which will cause him to take a more appreciative attitude towards the classroom work dealing with the stability and strength of ships. If possible, a few weeks' experience in a steamship office should be included in the training, so that the methods and practice of a steamship line can be observed.

If the above plan of practical training is followed, practically all the shop work can be dropped from the school curriculum. This will allow the time saved to be used for courses in literature, history and economics, which at present are not given enough attention.

The practical work in the course as outlined would require from a year and a half to two years of training outside of the classroom. I do not mean to assume that in this short time the student will become conversant in all the fields mentioned, or become skilled in any trade or branch of the profession. In fact, I fear he will have a rather superficial knowledge of the whole field, perhaps vague and obscure in some particular branch. Nevertheless he will have observed much that will incite his interest and study; he will have acquired a knowledge of materials, tools and processes; he will have seen the order and distribution of work and have learned to appreciate the money value of time and labor and material. He will also have obtained unconsciously an engineering instinct and a knowledge of proportions and dimensions of machinery and structure that will be invaluable to him in his college work. He will have mixed with different classes of men, discerned their points of view, and acquired a sympathetic understanding of them, which is of prime importance for one who may in the future be placed in charge of men. Most important of all, he will have seen the industrial world in operation and be imbued with its methods and spirit.

The College Curriculum

Having considered the practical side of the training, let us now turn our attention to the school curriculum. The professional studies should begin at the start of the freshman year and not be left, as is the present custom, until the third and fourth years. These early professional studies should be introductory courses in general engineering and naval architecture only, and the subjects should be treated in an elementary manner. The rigid mathematical treatment of the professional work should be left, as at present, until after the foundation work in mathematics, physics and mechanics has been covered. Short laboratory courses could be introduced in the freshman year with great benefit.

There are several reasons for starting the professional work early in the course, which are of paramount importance when the practical work is to follow the scheme I have just outlined. It is necessary that the professional work should parallel the outside practical training so that one will be an explanation and complement to the other; the student's enthusiasm and interest in his life's work should be aroused early and kept constantly at the highest pitch in order to accomplish the best results. These introductory courses will teach the student his limitations and create a greater incentive to master the more abstract sciences which are necessary for the study of theoretical naval architecture, ship design and construction. It is a fact that a student will assimilate very little in a subject that does not interest him; and any arrangement of the course that will create a lively interest and enthusiasm in mathematics, physics, thermodynamics, etc., will have a wonderful effect on the student's progress.

Courses in English should continue throughout the four years. The student's experiences and observation in his outside work will make excellent subjects for compositions and take away much of the antipathy that the student as a rule has for this subject.

Aside from these two considerations the present layout of the freshman year in most engineering schools fulfills the needs of the first year of a course in naval architecture. In arranging the course, the summer work to follow should be kept in mind, so that the outside time will be spent to the best advantage.

By the time the student reaches his third year he should be familiar with the principles of ship construction, the drawing and fairing of ship's lines, and the making of half models. He should also have covered the elements of naval architecture and general engineering and practically all of the work in physics, mathematics and chemistry.

The work in mathematics need only go through calculus. Any advanced work in mathematics should be left to the student's volition later in the course. A thorough mastery of the work in calculus and the ability to apply it in engineering work in later life is far more important than wading through more advanced work in differential equations with a rather vague knowledge of the whole course and little ability to apply it when the need arises. I do not wish to be understood as depreciating the more advanced work in mathematics. The student, by all means, should be encouraged to continue work in mathematics throughout the four years, if he has the proper aptitude. While this advanced work will be far in excess of that which can ordinarily be used in practice, it will fit him for any possible contingency that may arise in the future for original work.

The third year should start out with a technical study of ship design and the more advanced work in naval architecture. About the middle of the third year an actual problem in ship design should be started, which should continue until the end of the fourth year. This problem cannot be carried through exactly as it would be in practice, because many of the subjects will not be taken in class in time to be worked into the problem in their proper sequence.

Specific Problem Worked Out

The problem should consist, first, in selecting the proper dimensions, proportions and coefficients to meet an assigned condition. Then a preliminary estimate of weights, stability, trim, freeboard, deadweight and power should be made and a preliminary set of lines and arrangements plan be drawn up to see if the proposed boat meets the assigned requirements. Finally, a certain amount of the construction plans should be drawn and final calculations for weight, stability, displacement, power, strength, etc., carried out. It is extremely important that coefficients and data from good practice be available and the student taught to apply these to his design.

Let me amplify upon this problem in design, for it is one of the most important parts of the course. Here the student sees his professional studies applied to an actual design. The work on the problem is similar to that which he will be called upon to perform in the early part of his career. The theoretical work is illustrated, and the lectures made real and tangible by the application of their contents to the problem in hand.

The question of stability should be carefully covered in the problem by having the student design to a required minimum G. M. An actual calculation for the vertical center of gravity should be carried through. The required G. M. of the problem should be that for the ship

loaded ready for sea. The G. M. in the light condition should also be calculated, and should at least show no negative value. Zero ought to be the minimum. If necessary, the loaded G. M. will have to be increased to meet this condition. The value of metacentric height on the ship's behavior at sea might be studied at this point, and the necessity of keeping it as low as compatible with safety brought out.

After the main features of the design are finished, various details may be assigned to various members of the class to be drawn up and calculated for strength. One or two members of the class will probably work up the special details by themselves. The work of the individual men can be brought to the attention of the whole class by having the students gather around the various boards from time to time and talk over the work with the instructors. The following list suggests a few details that can be assigned: Stem; stern post, rudder and rudder bearings; propeller struts or bossing and stern tube; superstructure and house construction; masts, booms and winches and hatches; anchors and anchor gear; and the layout for boats and davits. Various parts of the shell plating, decks, longitudinals, inner bottom and bulkheads can be drawn up and calculated for strength by each student.

The following subjects should receive careful attention during the third or fourth years, and the ship, already in the course of design, could be used to illustrate them: Tonnage, deadweight and freeboard requirements, floodable lengths, watertight subdivision and location of bulkheads as required by the Report of the British Bulkhead Committee, Lloyd's or similar construction rules, longitudinal and transverse strength and strength of miscellaneous details, riveting, bulkheads, etc. Consideration should also be given to the power and propeller calculations, the drawing of the stern lines, and propeller bossing.

The proportions of the boat, the number, location and revolution of the propellers and the proper angle of the bossing for the most economical performance of the boat in service should be studied and discussed. Taylor's "Speed and Power of Ships" is by far the best text for the study of power and propellers.

Development of Original Designs

Too much attention should not be given to following the rules of the registration societies. A few weeks' work will familiarize the student with their use, which is sufficient. The main work in structural design should be of a more advanced nature, following the method of study as in Professor Hovgaard's excellent book, "The Structural Design of Warships." The naval architect must be able to understand and analyze the stresses that come upon a ship, and place the material most advantageously to resist these stresses. No advance in naval architecture can be accomplished by merely teaching the student to follow existing rules of ship construction, despite the fact that these rules are based on years of experience.

The work in marine engineering should take up such subjects as the selection and arrangement of the propelling machinery and auxiliaries, the heating surface, and fuel consumption of the boilers for a given steam consumption of the engines. After these points have been incorporated in the problem, a consideration should be given to the economics of steam engineering. This should cover such subjects as fuel consumption for various types of propelling machinery, boiler economy, feed heaters, economizers, effect of leaky condensers, etc. All these problems are given careful attention in power plants on shore, but are too often overlooked on shipboard. A good naval architect should be well versed in steam engineering and should be taught to study the economical problems of the machinery, as well as those of hull design.

Other subjects covered in the third year should include advanced mechanics, steam engineering and laboratory work, electrical engineering, hydraulics, metallurgy, English and economics of engineering.

In the fourth year the design problem should be continued and the more advanced parts of theoretical naval architecture be taken up. Some attention should also be given to heating and ventilation and aeronautics. A portion of the year should be given over to marine engineering, including engine design, steam turbines, boilers and Diesel engines. The importance of studying these subjects from the economic point of view has already been mentioned.

We should not lose sight of the fact that the design of a ship embodies nearly all branches of engineering, and, in mapping out the design, the naval architect must have sufficient knowledge to give all the problems preliminary consideration and due weight.

By the fourth year the student should be able to choose for himself what division of the field of naval architecture he hopes to follow. Highly specialized options in ship design, shipbuilding and ship operation should be introduced in the last year. This should be the only place in the course, however, where specialization is allowed, for the young engineer can seldom foresee what trend his career is likely to take. Men successful in naval architecture often, in later life, do not follow the particular line along which they start. Of two men, one with the broad grasp of the underlying principles and the other with a highly specialized knowledge of one branch, the former is better able to take advantage of opportunities for advancement.

Special Subjects

In addition to the subjects mentioned, some time should be given to training in yacht design because of its value in teaching the form and "sweetness" of ship's lines. The essentials of this field should be covered in case a student elects it as his life's work. History of naval architecture should receive treatment, if only by assigned reading, so that the student can face the future with an acquaintance of the achievements of the past.

The course in economics, after covering the fundamentals of the subject, should take up concrete problems in connection with the work in naval architecture. Such a problem as steam versus Diesel engines for a given trade route and given vessel could be discussed with regard to first cost, ability to obtain a supply of fuel oil, cost of operation, depreciation, repairs, etc. Or, again, a problem on the size of a ship for a certain trade could be taken up, and such points as interest on investment, time required in port for loading and unloading and opportunity to obtain a cargo be considered.

Such a course would require co-operation between the instructors in economics and naval architecture and talks by men actually engaged in shipping. The department of naval architecture could also introduce, at this time, the economic consideration of the design problem already under way.

Special attention should be given to laboratory work, as the student can acquire a great variety of knowledge and experience in the laboratory that he could only obtain after years of practical work in the industry. The students should carry on the work in the laboratory in small groups and be allowed to do everything themselves as far as possible. If it is an engine test, for instance, the students should start and care for the engine while running,

attaching the indicators and the other apparatus necessary. In short, the students should be given complete control and left to their own resources to work out the problem. The instructors and mechanics should interfere only when absolutely necessary. While I was on the faculty of the University of Maine, this used to be our practice, and the enthusiasm aroused and the results accomplished were very encouraging. We carried out a three-day plant test in this way, giving the students complete control even to the firing of the boilers. A recording steam gage, kept in the laboratory, gave a record of each student's firing and created much interest and competition among the men. I believe that more of actual boiler performance and methods of firing was learned by the student in his two lessons of firing than weeks of instruction could have accomplished.

CONCLUSIONS

The foregoing briefly outlines the field that should be covered for a training in naval architecture. Before concluding, I wish to add a few remarks regarding the method of presenting the work. The tendency in many of our engineering schools is to try to cover too much ground. As a result, the student graduates with a rather confused conception of the various subjects instead of a strong framework of the principles of engineering. The work, I believe, should be so taught that the main points are forcibly brought home and inculcated upon the student's mind, and the less essentials treated in a more cursory manner for the student to master at his own convenience as future occasions may demand.

First, he should receive a strong foundation in basic principles and theory and a strong framework in the professional studies, with as much amplification as time will allow. Then he should receive careful instruction to show him how to build upon this foundation and how to go about filling in the framework, by study and reading after graduation. It should be borne in mind that the student's training is not completed; in fact, it has just begun at graduation. It is true that the theoretical work is largely finished at this time, but there are years of practical work and experience ahead that must be tempered and rounded out by further study. This fact is too often entirely lost sight of by the young engineer and naval architect. It is the duty of the college faculty to point the way for his future development. Here professors who have had wide practical experience can draw on their own experience in pointing out the proper path for the graduate to follow.

Great care should be taken to see that the courses are properly interrelated, so that the student sees the connection and transition from one subject to another and is able to apply the basic sciences to his professional studies. An excellent way to do this is for the department of naval architecture to take the men after they have finished a course in mathematics, mechanics, etc., and put them through a short intensive review of the more important parts and illustrate this review with problems in naval architecture, ship construction, etc. For example, the course in mechanics could be reviewed in this manner by showing the application of the more important parts to ship design. Problems in strength of bulkhead stiffeners longitudinal shear in a ship's structure and the like should be assigned. This method brings about a clearer understanding of the subject by presenting it from an entirely new viewpoint.

The above proposal for obtaining interrelation of the courses is only given as a possible solution, and would probably need some modification before it could be put into practice.

Before graduation, problems should be assigned that will cover the work of several subjects in one problem. These problems will not only test the student's knowledge of the whole course of training, but also his common sense, judgment and ability to tackle original problems. Just to give one example: a problem on the electrical steering gear for a ship could be assigned. This would require a knowledge of rudders and the steering and maneuvering of ships, the friction of mechanism, the calculation of the power for the steering motor, an investigation of the torque and efficiency for electric motors, and, finally, the selection of the proper type of motor for the work. Many other problems of this nature in marine engineering, naval architecture and ship design will readily suggest themselves.

These suggestions for a course in naval architecture will tend to produce a course that is more practical and purely professional than the general run of engineering courses offered at present. For this reason it is very important that purely educational and humanistic subjects, such as history, English literature and economics, be included in the training.

The instructors in these subjects should be men of high ideals and broad education, so that the student will have the other side of his personality developed by association with men of such character. For the same reason, athletics and other student activities should be encouraged. We must not lose sight of the fact that one of the principal functions of a college is to make a man out of the boy—to teach him straight thinking and clean living. "In the making of a man all the rich forces of nature and civilization must have place." The trained architect should be a leader in the world, a man able to meet and understand the problems of the day as well as carry on the purely technical work of his profession.

The course of training as outlined is rigid and exacting. It will require the student's best attention and ability for five years. The vacations will be short, but the study and classroom work will be pleasantly interrupted by practical work in the yard shop and at sea.

With a course of training as suggested, the student will enter college with a clearer knowledge of his own qualifications and the scope of his profession; he will pursue his studies with a more appreciative attitude, and will recognize far better the application of theory to practice; he will leave school with a strong framework of the theoretical, economical and practical branches of naval architecture, with a clearer vision of his future, a more definite purpose, and a more intimate personal knowledge of what is required of him in the industrial world than the graduates of the past.

VICKERS' SUBMARINES.—In a period of fifty-one months of war, Messrs. Vickers, Ltd., built and commissioned fifty-four submarines of all classes for the British Admiralty. An interesting description of these vessels is given in a recent issue of *Engineering* (London), from which the following data are taken:

Type	Number	Length	Submerged Displacement, Tons	Horsepower
"E" class	15	181′	780	1,600
"V" class	4	147′ 6″	460	900
"G" class	6	187′	840	1,600
"K" class	6	339′	2,570	10,500
"N" class	1	......	......	......
"H" class	10	171′ 9″	510	960
"L" class	9	238′ 6″	1,090	2,600
Other types	3	......	......	......

UNITED STATES BATTLESHIP IDAHO

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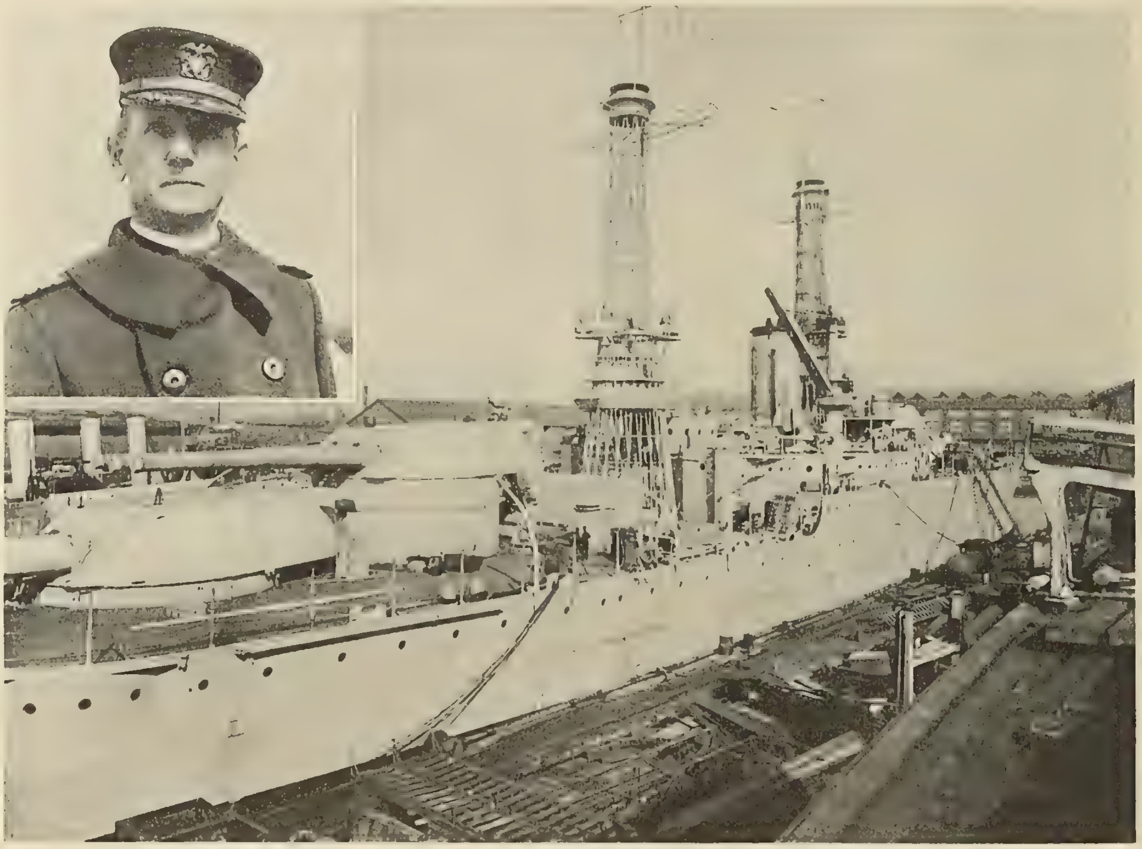
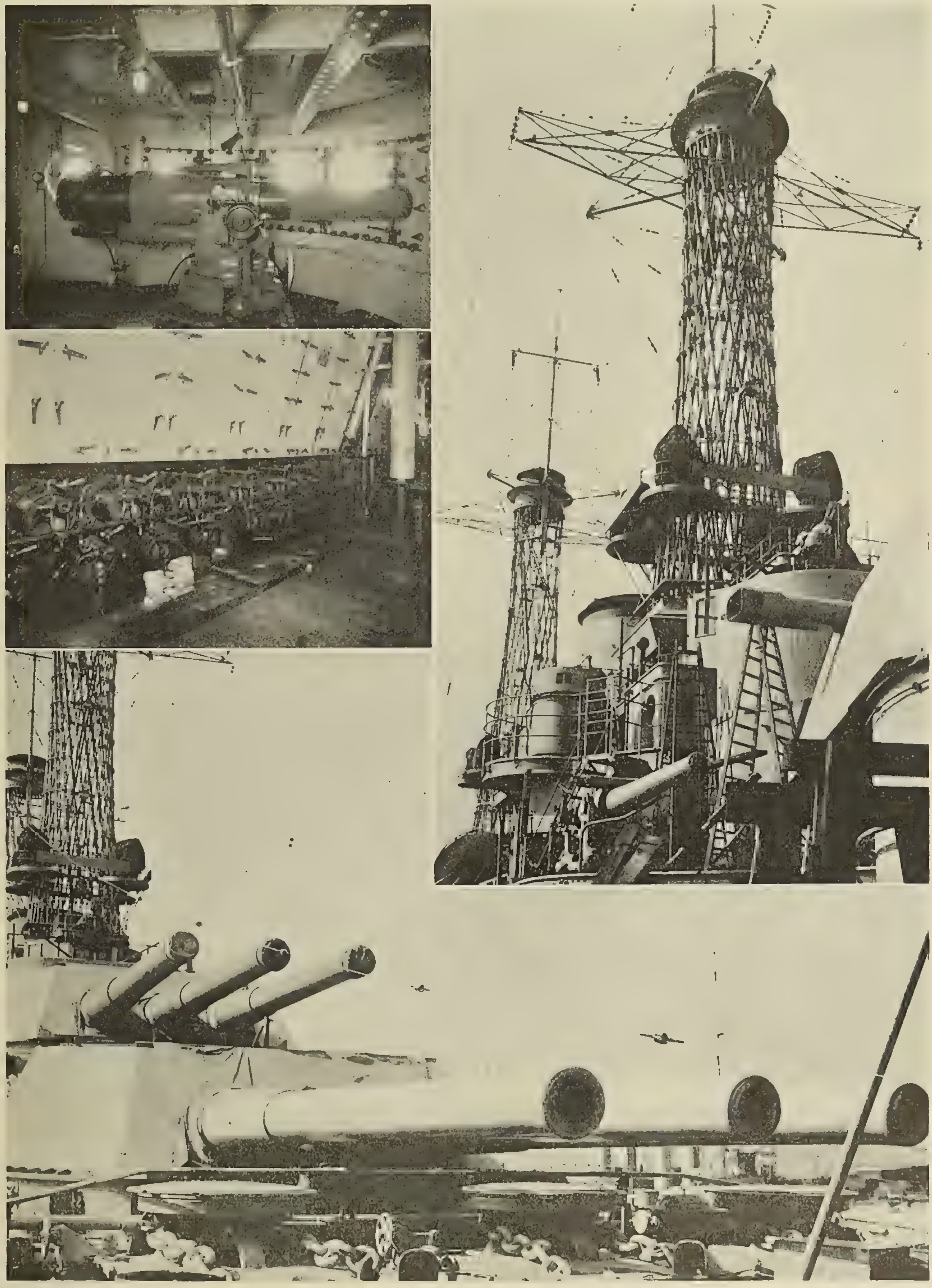


The *Idaho* and Her Commander, Captain C. T. Vogelgensang. The Stern of the Vessel Is Shown Below

The *Idaho*, Built by the New York Shipbuilding Corporation, Camden, N. J., Was Commissioned in March. Length, 634 Feet 6 Inches; Beam, 97 Feet; Mean Draft, 30 Feet; Displacement, 34,000 Tons; Horsepower (Parsons Turbines), 32,000; Armament, Twelve 14-Inch and Fourteen 5-Inch Guns

UNITED STATES BATTLESHIP IDAHO



Views on the *Idaho*, Showing After Turrets and New Wireless Aerials, One of the Guns of the Secondary Battery and One of the Firerooms

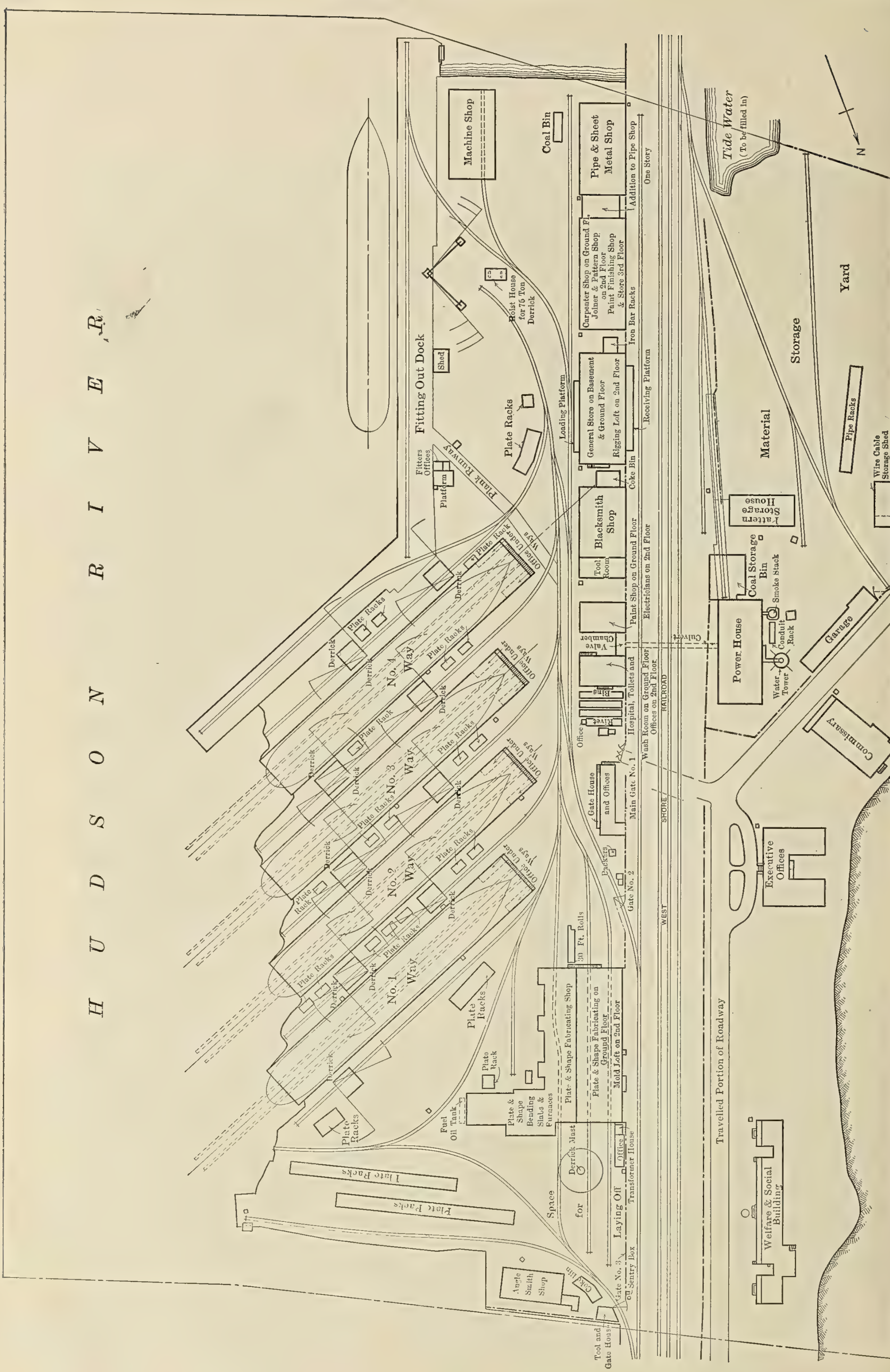


Fig. 1.—General Layout of the Newburgh Shipyard

Fig. 2.—View of Newburgh Shipyard from the Hudson River

Construction of the Newburgh Shipyard

Efficient Plant on the Hudson River Built in Record Time for War Work—A Story of Successful Accomplishment

A CAREFUL review of the accomplishments of American shipyards during the last two years of intensive shipbuilding shows to how great an extent success has been dependent upon suitable location, accessibility and environment—and this particularly is true with the shipyards born of the war emergency. It is, therefore, fitting that we present to our readers a description of the Newburgh Shipyards, Inc., whose record during the past year has been one of successful accomplishment.

Located about fifty-nine miles from the heart of New York city on the west bank of the Hudson River and one mile from the historical old city of Newburgh, this shipyard is served by the New York Central, West Shore, and Erie railroads, as well as several steamboat lines, both passenger and freight, operating between New York and Albany in addition to the New York State Barge Canal, connecting with Buffalo, so that ample and adequate transportation for men and materials is assured. The Hudson River at the shipyard is about one mile and a quarter in width and forty-four feet in depth, so that vessels of large tonnage and deep draft may be launched with ease.

Building Berths Limited to Four

The arrangement of shipyard, building berths and buildings was planned and laid out under the personal direction of Edwin C. Bennett, vice-president and general manager of the company. After a careful study of the most efficient shipyards in this country and Europe it was decided to limit the number of building berths to four, as experience has proved that under normal conditions, and particularly during periods of keen competition, the most successfully operated shipyards are those having an average of four building berths.

The yard as at present constituted has a waterfront of slightly over one-third of a mile in length and covers an area of twenty-four and one-half acres. The layout of the yard, as will be seen from Fig. 1, is so arranged that raw steel material is delivered at the north end and passes

Fig. 3.—S. S. *Newburgh*, First Vessel Built at the Newburgh Yard, Leaving for Her Trials

Fig. 4.—Panoramic View of Newburgh Shpiyard,

from one operation to another without at any time retracing its path, and the finished ship is delivered at the south end. Material, other than raw steel, enters the yard on a different line of rails, so as to avoid passing through that portion of the yard devoted to fabrication of steel. Material destined for the general stores is unloaded direct from the railway into the main storehouse without having to enter the shipyard proper.

Arrangement of Shipways

The four building berths as at present operated are each capable of taking a vessel up to 475 feet length between perpendiculars by 70-foot beam, but arrangements have been made for lengthening if occasion requires. They are spaced 100 feet on centers, so as to permit placing a standard gage railway track and storage racks for fabricated steel for material alongside each berth. The ready service storage racks alongside the building berths have been found of great advantage, as they permit the proper location of material as and when required, so as to enable the overhead cranes to operate at high efficiency.

The four building berths are served by twelve stiff-leg derricks mounted on towers, these derricks being so arranged that one ship, if so desired, may be served by five booms at one time. The booms are eighty feet in length and have a lifting capacity of five tons at extreme radius.

Fitting-Out Docks

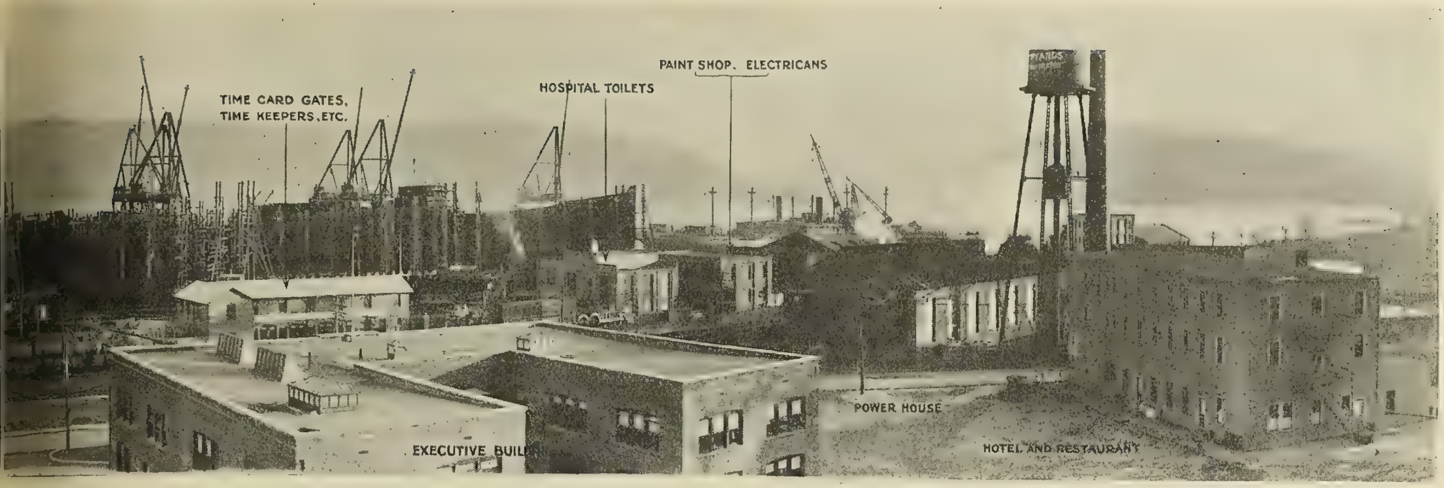
There are two fitting-out docks of a combined length of 1,010 feet, with railroad tracks thereon, so as to permit the economical handling of material direct to the ships afloat. The fitting-out crane is also of the stiff-leg derrick type, designed for a test load of ninety tons and a working capacity of seventy-five tons at eighty feet radius and a ten-ton capacity at one hundred and ten feet radius.

The work of building the shipyard commenced in July, 1917, and, whereas most shipyards made land by dredging the river front, the great depth of water and the heavy clay soil at the Newburgh yard prohibited this procedure. It was necessary, therefore, to excavate by steam shovel a hill on the west side of the main line of the West Shore Railroad and deposit it in the river on the east side of the railroad. Work proceeded apace, and, as will be seen from the photographs, sufficient land was made by September, 1917, to permit the start of building construction.

Layout of the Yard

The size and disposition of the various buildings are shown on the plan of the yard. The buildings are all of brick and concrete construction and comply with the rigid

Fig. 5.—9,000-Ton Steamer *Walden* as She Appeared on the Day of Her Launching, February 1, 1919



iowing Location of Principal Shops

factory laws of the State of New York. Washrooms and toilets for the workmen are installed on every floor in each building—in fact, throughout the plant the comfort and welfare of the workmen in the yard have received every consideration.

It will be noted that a very extensive arrangement of standard gage railway tracks permits the rapid and economical handling of material to all parts of the shipyard, and in keeping therewith seven locomotive cranes and a gasoline (petrol) shunting locomotive have been installed in addition to the stiff-leg derricks over the ships.

Progress of Ship Construction

The Newburgh shipyard has under construction ten steel cargo vessels each of 9,000 tons deadweight capacity. The keel for the first vessel, which was named the S. S. *Newburgh,* was laid on March 14, 1918, and delivered to the Shipping Board on December 30, 1918. The fourth vessel, named the S. S. *Walden,* after a small town in the Hudson River Valley, was launched on February 1, upon the occasion of which the Newburgh Shipyards, Inc., was commended by the Emergency Fleet Corporation for being the first new shipyard on the Atlantic coast building steel vessels to launch from the full quota of its ways.

With the publication of this article, six 9,000-ton vessels will have been launched and three vessels delivered, all within one year from the laying of the keel of the first vessel. The present building programme calls for the delivery of one vessel every six weeks. This enviable record is due partly to the excellent railroad and freight facilities, partly to the staff of highly skilled foremen and executives, all of whom have had many years of shipbuilding experience, and to a great extent to the efficient system of training unskilled workmen put into effect at the shipyard and the cordial relationship between the workmen and the management.

Training School Established

The management, anticipating the shortage of experienced shipyard labor, installed even prior to the laying of the first keel a thoroughly competent corps of skilled shipbuilders in its training center. All "green" men entering the employment of the shipyard passed through this training school, with the consequence that there has been built up a force of properly trained workmen, nearly all of whom are permanent residents of Newburgh and the surrounding villages. The yard is thus a local enterprise.

In order to consolidate the labor, the United States Shipping Board Emergency Fleet Corporation has recently constructed houses for the accommodation of two hundred families. Owing to the natural beauty of the ground on which these houses are built and its adjacency to one of the public parks of Newburgh, the design and arrangement of the houses are of an unusually pleasing style.

Details of Vessels Built

The vessels now under construction at the Newburgh yard are of the two-deck, three-island type, with two pole masts and one stack. Each mast carries four cargo booms of five tons' capacity, with a thirty-ton boom for handling heavy loads. There is a large hatch to each hold; those to holds 1, 2, 4 and 5 are 29 feet 3 inches by 20 feet, and that to hold 3 is 18 feet by 20 feet. The crew is berthed in the poop, while the bridge deck enclosure is given over to cargo and the forecastle to storerooms, carpenter shop, lamp rooms, etc. The officers are housed in two houses on the bridge deck, the navigating officers occupying the forward and the engineering officers the after house. These vessels are of the following dimensions:

Length overall	417 feet 10 inches
Length between perpendiculars	401 feet
Breadth molded	54 feet
Depth molded	32 feet 10 inches
Designed draft	25 feet 6 inches
Deadweight carrying capacity	9,000 tons
Capacity for grain cargo	476,205 cubic feet
Capacity for fuel oil	1,260 tons
Capacity for bunker coal	1,846 tons
Capacity for feed water	137 tons
Capacity for drinking water	26 tons
Gross tonnage	6,099 tons
Net tonnage	3,783 tons

The vessel is driven by a 17-foot propeller operated by a Westinghouse turbine reduction gear. The turbine is designed for 3,600 revolutions geared down to 90 revolutions of the propeller shaft, giving an output of 2,800 shaft horsepower. Steam is furnished by three Babcock & Wilcox boilers of 200 pounds per square inch steam pressure and a total heating surface of 8,700 square feet.

Trial Data

The S. S. *Newburgh* and the S. S. *New Windsor* were transferred to the Naval Overseas Transportation Service for operation, and extracts from the deep-load sea trial of the *Newburgh* will illustrate the rigid trials that these vessels went through before acceptance. This trial constituted both an endurance and a speed trial, as the vessel

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Fig. 6.—Newburgh Shipyard as It Appeared on September 20, 1917. Taken from South End of Mold Loft

Fig. 7.—View of the Yard as It Appeared on February 17, 1919. Taken from South End of Mold Loft

was run with the engines running at maximum capacity for twelve hours, of which three hours formed the speed trial, from which the following data have been taken:

Trial Data

Duration of full speed trial, hours	3
Average revolutions per minute	94.94
Estimated shaft horsepower	35.50
Vacuum, inches	27.4
Fuel oil, pounds per hour per shaft horsepower	1.34
Estimated speed, knots	12.4

Notwithstanding the fact that the above sea trial was very much in excess of the contract requirements, the vessel passed through these trials satisfactorily and shortly afterwards proceeded on her first trip to Europe.

New Baltimore Shipyard

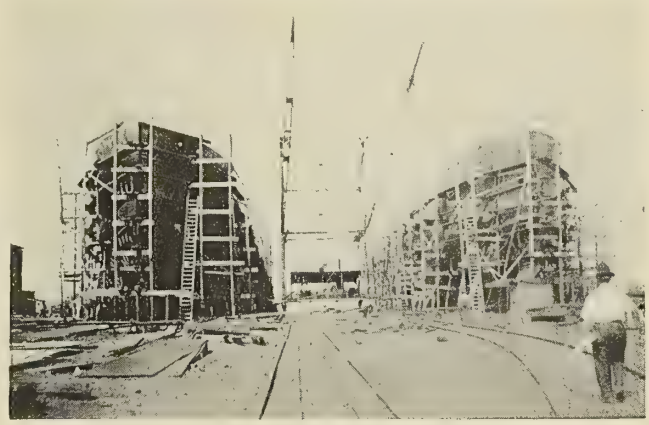
BY FRANK G. REINHARDT, JR.

In the Union Shipbuilding Company on the Patapsco River, at Fairfield, Anne Arundel County, Baltimore is gaining an important addition to its already large shipbuilding industry. Besides the many independent shipbuilding projects which sprang into existence to meet the great war demand for tonnage, some of the largest steel-producing interests of this country, including the United States Steel Company and the Bethlehem Steel Company, have established plants to build steel steamships as an added form of consumption for their primary product. In a somewhat similar manner the Union Shipbuilding Company is an offspring of the large steel interests of the McClintic-Marshall Company, of New York and Pittsburgh.

When the McClintic-Marshall interests took over the plant of the Ellicott Machine Corporation on the old quarantine grounds on the Patapsco River only two small timber ways, upon which dredges for the Panama Canal had been built by the Ellicott concern, were standing, besides an inadequate punch shop, a small mold loft and an office building. In order to lose no time, and to take advantage of present facilities, these two ways were immediately strengthened by the Union Shipbuilding Company, and two steel oil tankers, the *Monongahela* and the *Ohio,* were laid down for the Gulf Refining Company, Port Arthur, Tex., and later successfully launched.

In the meantime, work was rushed to construct two more timber ways, the contract for which was awarded to the Sanford-Brooks Company. Pile drivers with their active crews were soon upon the scene and worked steadily day and night. These two ways measured 400 feet in length and were completed in fast time. The keels for two large cargo steel barges for the Aluminum Ore Company of America were immediately laid on the new ways. Work on these two ships is rapidly nearing completion, and the hulls will no doubt be sent overboard shortly. These vessels are 315 feet in length, with a beam of 48 feet 6 inches.

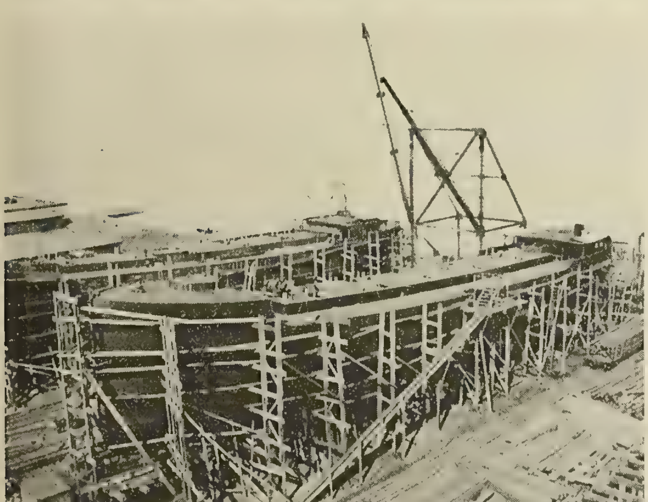
Erection of New Plate and Angle Shop



Monongahela and *Ohio* During Construction

Plate Fabricating Shop

The erection of a large modern plate shop was also completed, and this is now rapidly turning out fabricated steel for the ships on the ways. During the war the



Ship Under Construction on Ways Nos. 1 and 2

S. S. *Ohio* Just After Launching

Union Shipbuilding Company turned out thousands of tons of fabricated steel, which was used at the mammoth Hog Island plant. The plate shop is built on the daylight plan and is equipped with the latest types of punches, shears and reaming machines, steam hammers, planers, radial drills, cold presses and riveting machines. The plates are quickly handled by a score of Shepard electric hoists operating on trolleys overhead. Plate and angle furnaces were also erected and quickly put into operation.

Reinforced Concrete Shipways

After the launching of the *Monongahela* and the *Ohio*, ways Nos 1 and 2 were torn down and two modern reinforced concrete ways are at present under construction to replace the old timber ways. One of these ways is completed and is ready to receive its keel, while the other is rapidly nearing completion. These ways are 400 feet in length by 65 feet wide and will be covered, thus enabling work to proceed throughout the year in all kinds of weather.

Two more ways of like dimensions will be built to replace the timber ways Nos. 3 and 4, and it is planned to add other ways of larger dimensions. Outfitting piers 500 feet in length are now being built, while it is proposed to construct a large reinforced concrete dry dock.

Cranes

Large cranes of the traveling type, supplied by the Heyl-Patterson Company, of Wilmington, will be installed at the head of the ways to facilitate and expedite the delivery of materials to all ships under construction. These cranes are of the portable tower crane type, having a third rail to supply them with the electric current needed for their operation. Heavy reinforced concrete runways with pile-driven foundations are now under construction for these cranes.

A large floating crane will also be put into service to speed up the work of fitting out the ships at the piers.

A new office building was recently completed, and the various departments of the company have taken possession. This building is of fireproof tile construction with a stuccoed finish. It has two floors and an attic and measures 250 feet long by 50 feet wide. A large warehouse of the same construction is also being built.

The present shop facilities will be greatly enlarged to meet the increased production, and a large gantry crane will operate across the entire width of the yard. A larger and spacious mold loft is also planned, and, as the need arises, new office buildings will also no doubt be erected.

Construction Camps and Commissary

In order to make it more convenient for the shipworkers at the plant, the Union Shipbuilding Company has constructed camps and a commissary. At a nominal fee, the workers can board at these camps and can secure any necessities of life at the commissary.

The contracts for the construction work have all been awarded to the Hughes-Foulkrod Company, Philadelphia, while all the pile-driving and waterfront work is done by the Empire Engineering Company.

As planned and equipped, the Union Shipbuilding Company will become one of the large units of ship production of this country. When completed, the plant will contain facilities for the construction of fourteen vessels at one time. The shipyards in Baltimore launched during 1918 nearly 180,000 tons of steel ships, and with this new productive capacity added to that which already exists, and with a continuance of the great demand for steel merchant bottoms, the Union Shipbuilding Company should add at least another 80,000 tons yearly.

As in the case of the United States Steel Company and the Bethlehem Steel Company, the Union Shipbuilding Company will receive much of its material for ship construction from the other plants controlled by the McClintic-Marshall interests, which are located at Leetsdale, Rankin and Pittsburgh. By this process of fabrication, the time required to build a steamship is materially reduced.

The plant of the Union Shipbuilding Company is reached by the Baltimore & Ohio Railroad, while the United Railways & Electric Company, of Baltimore, has extended its tracks to Fairfield. This enables the shipworkers to be in close and convenient touch with their homes in Baltimore. From 3,000 to 5,000 men will be employed at the new yard.

Government Building Large Number of Small Marine Gas Engines at Norfolk Navy Yard

At the Norfolk Navy Yard the Government is operating the most extensive marine gas engine plant in the United States. Since August, 1917, the yard has received orders to build 2,296 engines of what is known as the navy type.

These are two-cycle engines and are used in small boats. They are one-, two-, three- and four-cylinder, or 5-, 10-, 15- and 20-horsepower, and were designed by the Bureau of Steam Engineering and the machinery drafting division of the Norfolk Navy Yard. The yard has been building these engines since 1913, and at the present time there are about 2,000 of them in use. The number of engines built since August, 1917, represents 23,355 horsepower, and of this number 1,384 built in 1918 represent 14,075 horsepower. The banner month for engine production was September, 1918, when 201 were built.

The progressive method in use in the automobile factories is followed in the main gas engine shop, and the parts follow a straight line down the shop, emerging a finished engine ready for the testing shop. They are given a 12-hour running test to develop any defect and are then stored subject to order.

Many of the engine parts are made at the navy yard, and only a few are bought commercially. When the parts start on their way through the shop they are first machined, then assembled, inspected and stored. Then they go to a progressive assembly track about 100 feet long and having ten stations. At each one of these stations the engine receives one or more of its parts and quickly develops into a finished product. When the engines leave the assembly track they are shunted onto a transfer and carried to the testing shop.

It has been stated that there is no private plant in the country which is able to compete in volume of output with the Norfolk Navy Yard in producing this type of engine. A force of about 200 workmen is employed at present.

Brown-Curtis Double-Reduction Geared Turbine Installation.—In a recent installation of Brown-Curtis double-reduction geared turbines made by the Wallsend Slipway and Engineering Company, Ltd., on a single-screw cargo steamer of about 9,100 tons deadweight capacity built by Messrs. Sir W. G. Armstrong, Whitworth and Company, the propelling machinery consists of three turbines working in series. The high- and intermediate-pressure turbines run in tandem, operating one pinion, while the low-pressure turbine operates a separate pinion, the power transmitted through the pinions being practically equalized.

Foundation Company's New Orleans Yard

Located on New Ship Canal Connecting Lake Pontchartrain with the Mississippi River—"Unsinkable" Ships Under Construction

WHEN The Foundation Company (New York) drove the first piles for its New Orleans shipyard last spring, the nearest navigable water was five miles away. Since then dredges working on the new industrial canal for the city of New Orleans have cut a channel to the shipyard site, and before the first vessel is ready to start on her trial trip the canal will be open to deep water.

The location of a yard at New Orleans involved conditions differing widely from those in other parts of the country. The Mississippi River has a range of over 20 feet in elevation, making it unsafe to cut through the levee for launching ways. Lake Pontchartrain, on the other hand, has a depth of only about 9 feet, which is, of course, insufficient for large-sized vessels.

To overcome these disadvantages, the city of New Orleans has undertaken the construction of a ship canal from the river to the lake. A lock is being built near the river bank, so that the water in the canal will always be maintained at the level of Lake Pontchartrain. The ordinary variation in the lake is only 2 or 3 feet, due to the small tide in the Gulf of Mexico. After heavy storms, there may be a variation of as much as 8 feet, but this is exceptional.

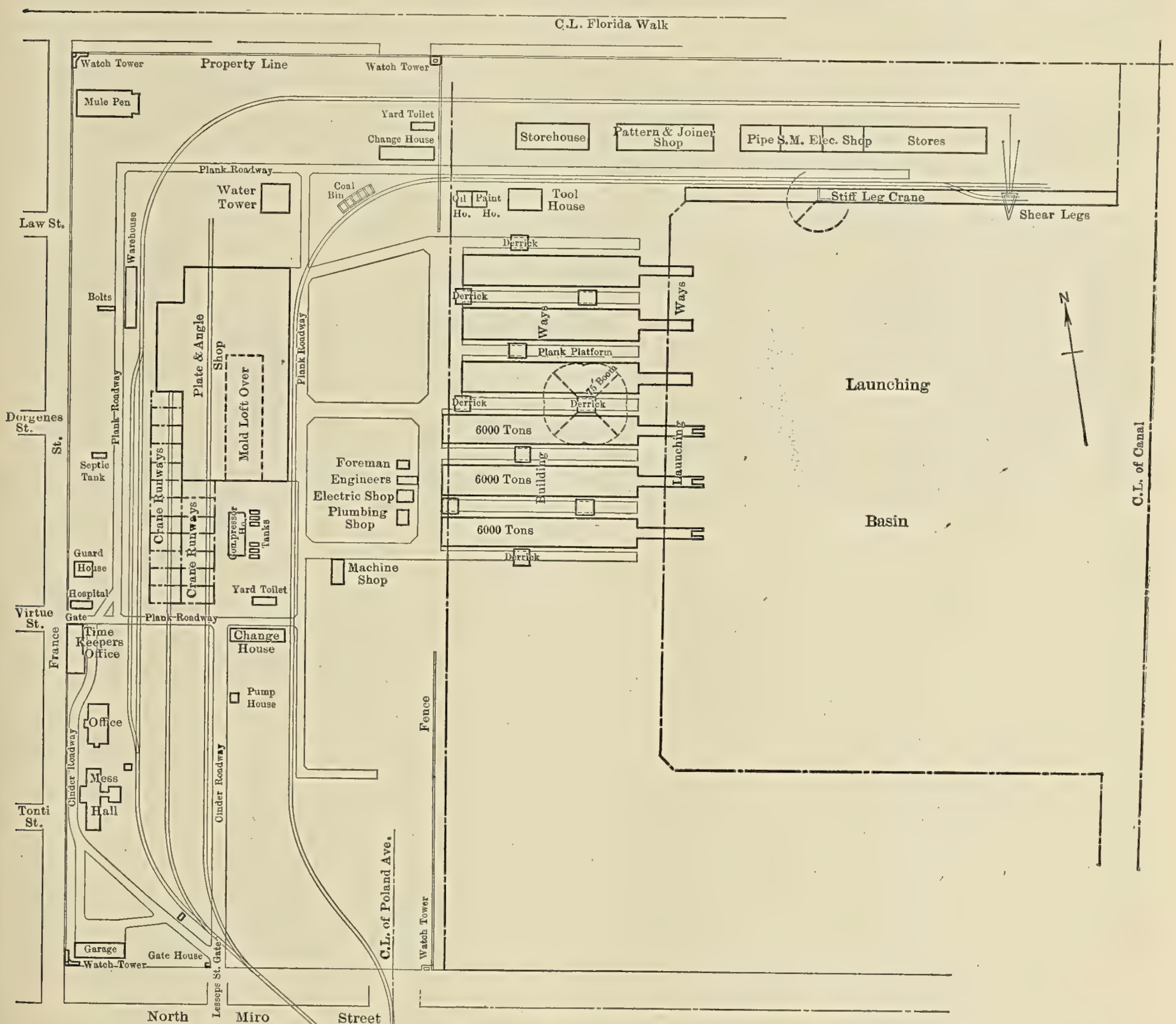


Fig. 1.—General Arrangement of the Yard

The canal will provide an inland waterway accessible to ocean vessels, which can proceed directly to the manufacturing plants established along its margins. An excellent shipyard site is also provided beside the wide turning basin at about the mid-length of the canal.

The property developed by The Foundation Company is on the west bank of the basin, adjoining a built-up section of New Orleans. As electric cars provide quick access to the center of the city at a minimum fare, no hous-

ing problem for labor is involved. The yard is served by the Belt Line railroad and supplied with water and electricity from the city systems.

The size of the turning basin will permit end launching of the hulls, which has advantages over side launching in economy of waterfront and ease in handling material. There is ample space also for laying up vessels to be fitted out.

Layout of the Yard

Raw steel is brought into the yard on a standard gage railroad track and is distributed in the storage yard so that plates are near one end of the plate and angle shop, and angles and shapes near the opposite end. Steel is unloaded from the cars and stored by locomotive cranes. These cranes also load the material on small cars and push them into the ends of the plate and angle shop, where the material is handled by an overhead traveling crane.

Plate and Angle Shop

As shown by Fig. 1, the plate and angle shop is located in the center of the yard, just far enough from the head of the building ways to leave ample space for the storage of fabricated material before erection in the hulls. The roof is of saw-teeth construction, with provision for ample lighting of the interior.

A craneway runs along the entire length of the west side of the shop and extends beyond it 315 feet over the steel storage yard. A five-ton electric crane handles raw stock coming into the building from either end, loads stock on working skids from cars, or places stock so that it can be picked up by one of the two-ton hand cranes, which extend over the nine smaller bays along the east side of the shop.

In the main bay of the shop, where raw material is received, are the layout skids for plates, angles and shapes. The plate and angle furnaces are in a lean-to at one side. Each cross bay is laid out to handle a separate class of work and contains the tools necessary for the operations to be performed.

Method of Handling Fabricated Materials

The yard was originally laid out with railroad tracks running to the shipways. Locomotive cranes were to be provided, so that cars could be unloaded either at the storage piles or at the ways. This method was abandoned later on, however, and a tractor system submitted. The yard is equipped with five small gasoline (petrol) tractors, which can travel from 3 to 20 miles an hour. A number of four-wheeled trailers are also provided. A system of plank roadways is built through the plate and angle shop and around the yard, so that tractors and trailers can carry materials to any point where they are needed. Light pieces are loaded and unloaded by hand; heavy pieces are loaded at the shop by the two-ton overhead cranes and are unloaded at the storage piles by small stiff-leg derricks conveniently located. When fabricated work is taken directly to the ways, the trailers are unloaded by the tower derricks.

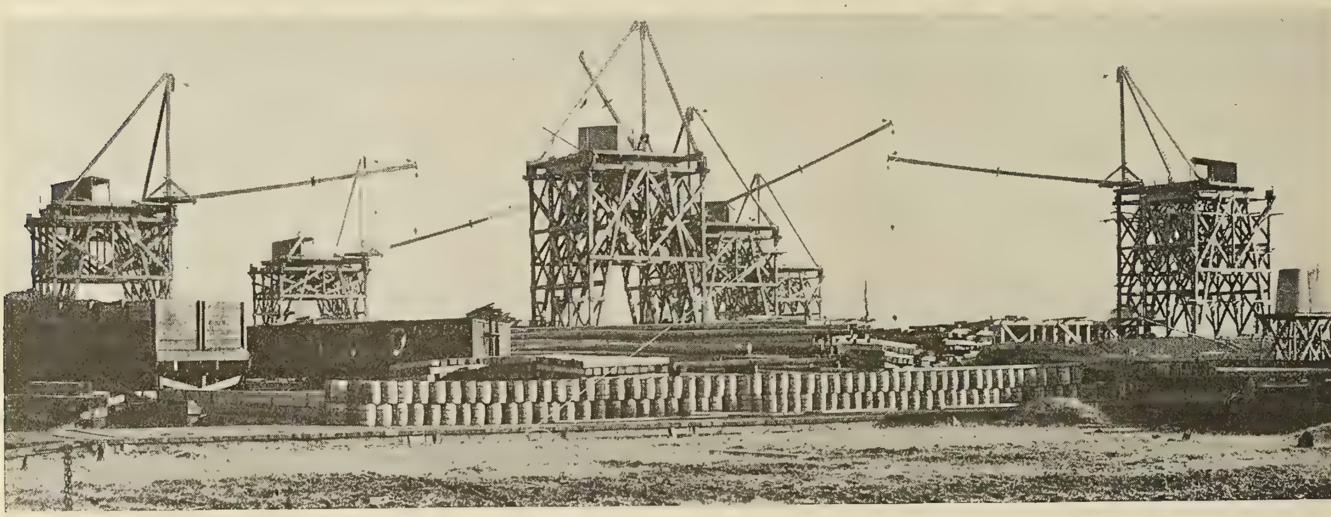


Fig. 2.—Tower Derricks at the Shipways

Fitting-Out Wharves

Wharves are constructed along the side of the launching basin for use in fitting out the hulls. A 10-ton derrick is set up on one of these wharves and a 65-ton shear leg on the other wharf. This "shear leg" has a lifting capacity of sixty-five tons, sufficient to permit handling a Scotch boiler from a flat car to the hull.

The buildings used in fitting out the vessels, such as the joiner shop, sheet metal shop, electrical shop, pipe shop and storehouse for fittings are all located conveniently to the wharves. Standard gage railroad tracks and planked roadways for motor trucks are provided for the delivery of materials. From these shops fabricated materials will be delivered to the wharves by motor tractors.

Secondary Buildings

The sub-station and compressor house is located near one end of the plate and angle shop in such a position that it can furnish air to this shop and also for use at the ways with a minimum length of distributing lines. Motor-driven air compressors of 4,500 cubic feet capacity are installed in the compressor house, and are operated by 2,300-volt alternating current motors, taking current directly from the city distributing system. Motor generator sets are also provided in this building for furnishing direct current for crane and derrick service throughout the yard.

The main office buildings, timekeepers' office, change houses for the workmen and a hospital are conveniently located near the main entrance of the yard, which is placed so that the workmen will have a minimum distance to travel after entering the yard to reach their work.

At present there are three building ways, but space has been left and the whole layout arranged so that five additional ways can be installed. There is also room for the construction of a complete repair yard with drydock facilities.

The Foundation Company is building at this yard for the French Government five 4,250-ton deadweight steel cargo steamers of the Le Parmentier "unsinkable" type.

Le Parmentier "Unsinkable" Type Ships

Unlike previous designs, which involve modifications of a standard cargo steamer, the Le Parmentier design makes a radical departure from usual forms of ship construction. As will be noted from Fig. 3, the general external appearance of the vessel resembles the whale-back steamers which have been operating successfully for many years on the Great Lakes. The cross section of the vessel, however, instead of being of the usual U-shape, is in the form of two circles side by side, connected above and below by curved segments (see Fig. 4).

The hull consists of two parallel cylinders 20 feet in diameter, arranged horizontally side by side and connected by transverse watertight bottom and deck, as shown in the cross section. The cylindrical form not only gives maximum strength, but also provides double inner longitudinal walls to localize flooding of the hull if the outer skin is ruptured.

The entire hull is stiffened and given further protection from flooding by seven watertight bulkheads (shown dotted on deck plan, Fig. 3). These bulkheads being continuous from side to side form watertight compartments in each of the cylinders and in the "reserve buoyancy" space between them. The hull is thus subdivided into twenty-four separate watertight compartments.

The general dimensions of the steamers now under construction are: Length overall, 328 feet 4 inches; length on load waterline, 314 feet 9 inches; beam, 46 feet 5 inches; draft (maximum), 16 feet 1½ inches.

The propelling machinery will consist of twin triple-expansion, 700-horsepower engines, designed to give the vessel a speed of approximately eight knots loaded. Steam will be supplied by Scotch boilers fired with oil fuel. As one complete power plant is installed in each half of the hull, the vessel can be brought into port even though one side has been completely flooded.

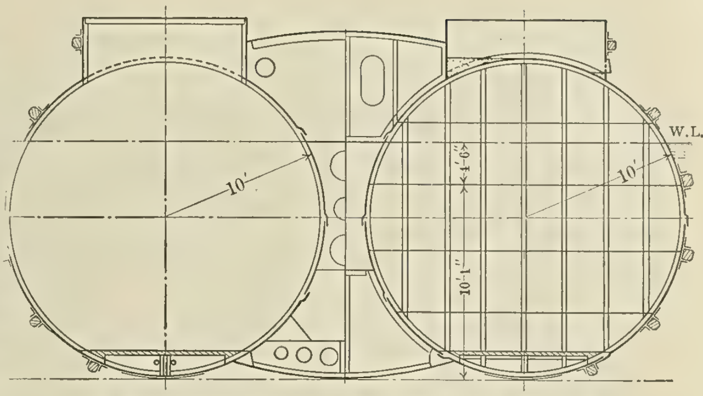


Fig. 4.—Transverse Section of Le Parmentier Type Ship

The vessels are being built under the inspection of the "Bureau Veritas." According to the present schedule, the first hull will be launched early next summer.

Other Foundation Yards

The New Orleans yard is the largest of the three steel shipbuilding plants controlled by The Foundation Company, the other two being located at Savannah, Ga., and Port Huron, Mich.

The Foundation Company's experience in shipbuilding began in July, 1917, when it laid the keel of a 3,500-ton Ferris type ship for the Emergency Fleet Corporation. Since then it has completed forty wooden auxiliary schooners and fifteen cargo steamer hulls, with a total deadweight capacity of 169,000 tons—a greater production than is credited to any other wooden shipbuilding organization in the country.

The executive heads of The Foundation Company are Franklin Remington, president, and John W. Doty, vice-president. All construction is under the supervision of H. J. Deutschbein, general manager, with C. A. D. Bayley and Bayley Hipkins vice-presidents in charge of shipbuilding on the Atlantic and Pacific coasts respectively. Hewitt Crosby is manager of the New Orleans shipyard.

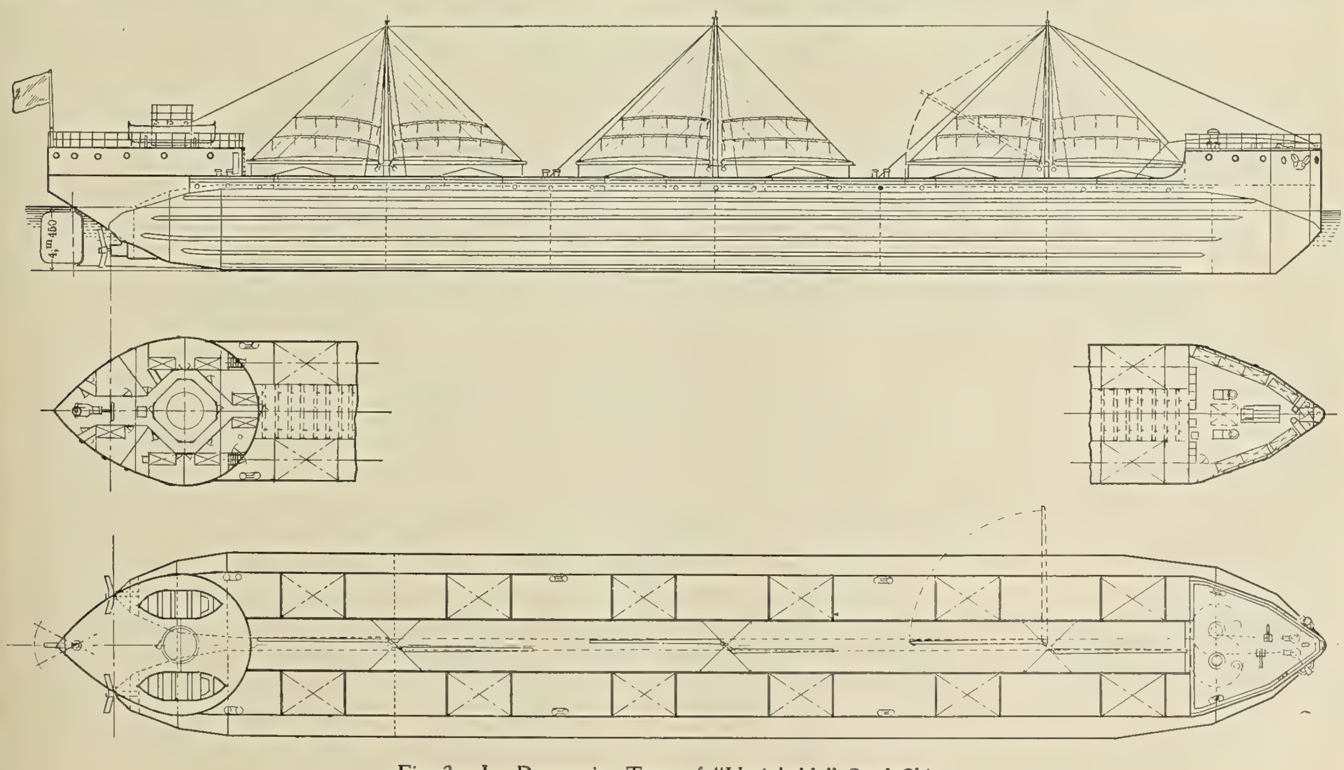


Fig. 3.—Le Parmentier Type of "Unsinkable" Steel Ship

Fig. 1.—View of Carolina Shipyard, Showing Outfitting Pier in Course of Construction; Sheet Metal and Blacksmith Shops; Pipe and Coppersmith Shop; Carpenter and Joiner Shop; Power House; Storehouse. In the Background Are the Derrick Towers at the Four Shipways

Carolina Ship Building Corporation

New Yard Erected for Building Emergency Fleet Vessels —Contract Calls for Twelve 9,600-Ton Cargo Ships

THE United States Shipping Board Emergency Fleet Corporation entered into contract with the Carolina Ship Building Corporation on April 17, 1918, by which the Carolina Ship Building Corporation, acting as superintendent for the Fleet Corporation, was to construct a shipyard plant at Wilmington, N. C., and also twelve 9,600-ton deadweight capacity steel cargo steamships.

The general scheme involved the fabrication of the midship section of the hulls (about 55 percent of the total tonnage of the hulls) in bridge and structural shops, and the fabrication of the molded or fore and aft ends of the hulls in the new yard, and the purchase, outside, of the engines, boilers, pumps, condensers and all such mechanical and some other features.

The plans of the yard were prepared by the Carolina Ship Building Corporation and provided for four shipways, fabricating shop, mold loft, sub-station and compressor house, machine and pipe shop, blacksmith shop, sheet metal shop, carpenter and joiner shop, outfitting pier, storehouse, time-keeping office, outside superintendents' office, first-aid hospital, mess hall and administration building.

Location of the Yard

The yard is located on the east bank of the Cape Fear River, about three miles south of the business center of the city of Wilmington, and about twenty-three miles from Cape Fear lighthouse at the mouth of the river. There is a 26-foot depth of channel, dredged and maintained by the United States Government, from the sea to the northern end of the city waterfront.

The property, purchased by the Fleet Corporation of the Seamen's Friend Society and others, consists of 103 acres, with 1,800 feet of frontage on the river. A part of this property, about one hundred years ago, was the site of a hospital used in connection with a plague that the city suffered, and during the Civil War the same point was the site of the Confederate Fort Lee. The fence surrounding the shipyard encloses about 48½ acres and takes in 1,150 feet of the waterfront.

The first survey party arrived on the property on April 18, 1918, and the first earth was moved and actual clearing for construction work commenced on May 28.

Change in Plans

The original plans located the outfitting pier at the south side of the yard, with the shipways to the northward. In June the Fleet Corporation ordered the construction of the yard after a plan that would provide for the ultimate construction of eight shipways. The shipbuilding corporation and the resident representative and plant engineer of the Fleet Corporation then prepared revised plans for the yard on that basis. The waterfront topography to the north of the northernmost of the four ways was low and boggy, and it was found that the most economical plan for the eight-way plan was to transfer the outfitting pier from the southerly to the northerly end of the property, even at the expense of abandoning the piles that had already been driven for the outfitting pier at the original site. Only about one-half of the total number of the piles for this pier had been driven, and if the G and H ways are built these piles can be used to form a pier which will be quite useful.

A short time after this a verbal order was given to the shipbuilding corporation to build a total of six ways instead of four ways, as originally planned. The construction was carried on until October 15 on this plan, but on that date the order for the two additional ways was cancelled. This cancellation, of course, not only affected the two additional shipways, but other features of the plant that had been added to balance the production.

The plant construction, with the exception of the under-

Fig. 2.—Fabricating Shop

water portion of the shipways, was completed on February 15, 1919.

Railroad Connections

It will be observed that the railroad tracks enter the yard at the northeast corner. The tracks are the property of the Tide Water Power Company, the local public utilities concern. For a distance of about two miles from the shipyard to a junction with the belt line of the Atlantic Coast Line Railroad, the line of the Tide Water Power Company is double-tracked. Both of these tracks are used by the electric cars of the power company for transportation of the yard employees during the rush hours in the morning and evening, and one of the tracks is used by the steam locomotives of the shipyard for freight service during the other hours.

The steel plates, shapes, etc., to be fabricated in the yard

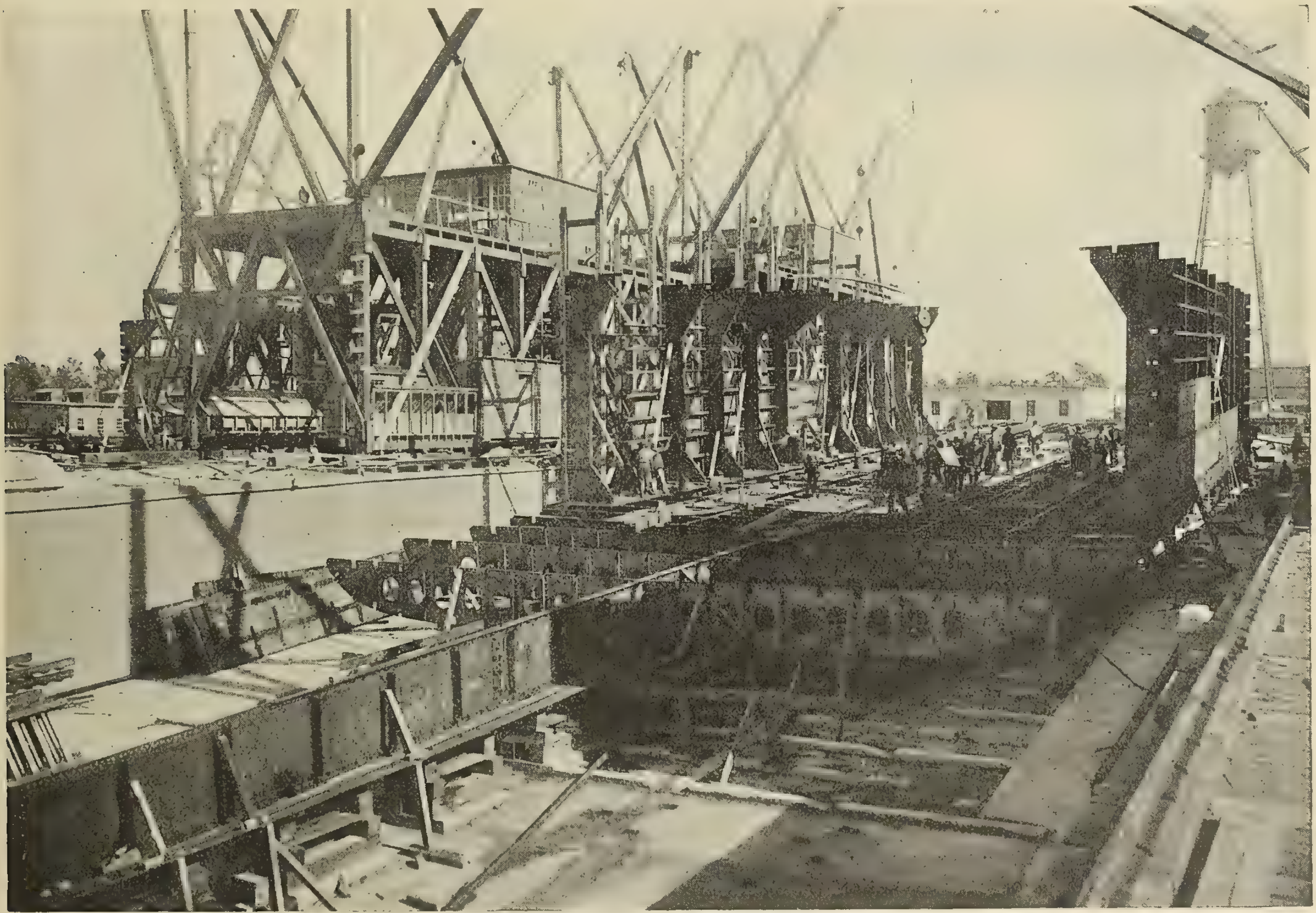


Fig. 3.—Riveters Working on the Hull of the S. S. *Cranford*

are unloaded and stored to the east of the fabricating shop. Plates are placed on edge in racks; shapes, universal mill plates and bars are piled.

Storage of Materials

Hull steel, fabricated outside, is unloaded and stored adjacent to the tracks from the entrance to the yard to the curves toward the river, between the mold loft and the fabricating shop, to the south of the fabricating shop and in front of the ways. Racks are provided in the triangular spaces between the tracks in front of the ways for plates that come to the yard punched by the outside fabricators.

Outfitting materials and equipment are unloaded and stored along the tracks leading from the entrance to the outfitting pier or stored in some of the buildings of the outfitting department, or in the storehouse, depending on the nature of them.

Yard Crane Equipment

Locomotive cranes are used for all yard work, unloading, storing and re-loading. The total length of tracks in the yard is about six and a half miles. The rails (67.5 pounds per yard), splices, bolts and spikes are Russian Government railway standard, rolled in the United States on Russian order. They have given good service and are said by those who built and are maintaining the tracks to have several points of merit.

The two crane runways, located east and west of the fabricating shop, are to be installed when the second fabricating shop is built.

The mold loft is 80 by 250 feet, steel frame, with wood and glass sides and ends, and wood sheathing and paper roof, and white pine floor.

Adjacent to the mold loft is a specially designed building of frame construction for the storage and care of all templates.

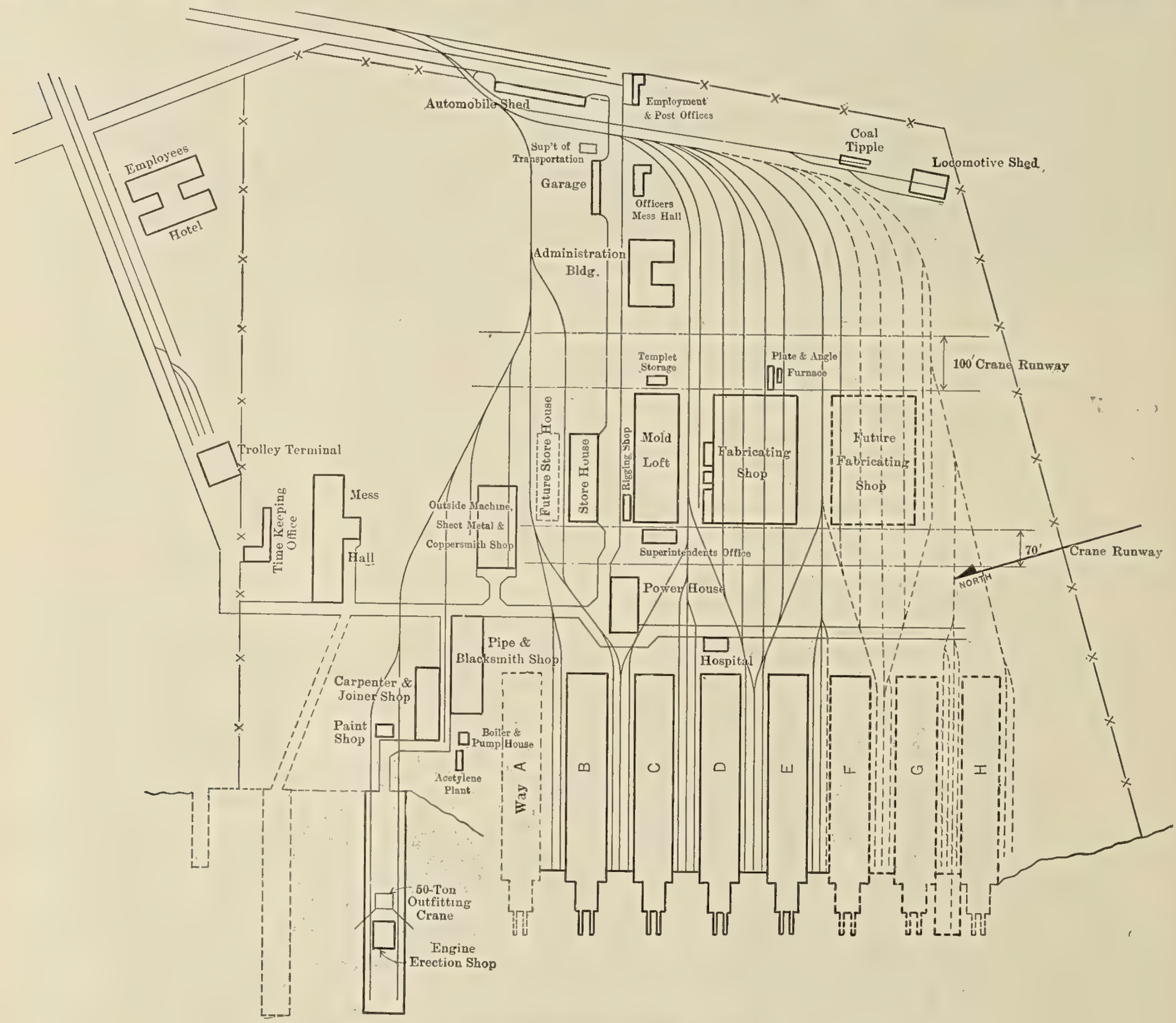


Fig. 4.—Layout of the Carolina Yard

Fabricating Shop

The fabricating shop is 160 by 250 feet, steel frame, with wood and glass sides and ends, and wood sheathing and paper roof. All the roof trusses are designed with bottom-chords of two channels forming tracks for electric overhead hoists running the full width of the shop. All transverse movements of material are therefore made with the electric overhead hoists, operated from the floor, and the longitudinal movements are made on buggies with roller-bearings on the four standard gage tracks which run the full length of the shop. The equipment of this shop includes a plate furnace, an angle furnace, a rivet-making machine, a set of bending rolls 30 feet between

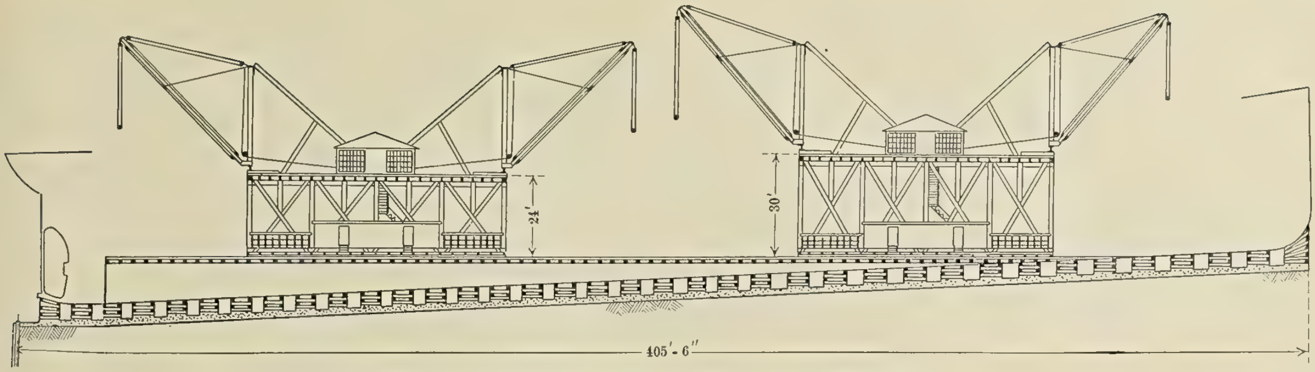


Fig. 5.—Longitudinal Section on Centerline of Shipway

housings, and the usual shears, punches, drills, reamers, riveters etc. Material after fabrication in this shop is taken direct to the shipways or stored in the space shown outside of the west end of the shop. The floor of this shop is of untreated wood blocks 6 inches long cut from the stumps and butts of trees cut in the clearing of the yard site. Located near the fabricating shop is a small,

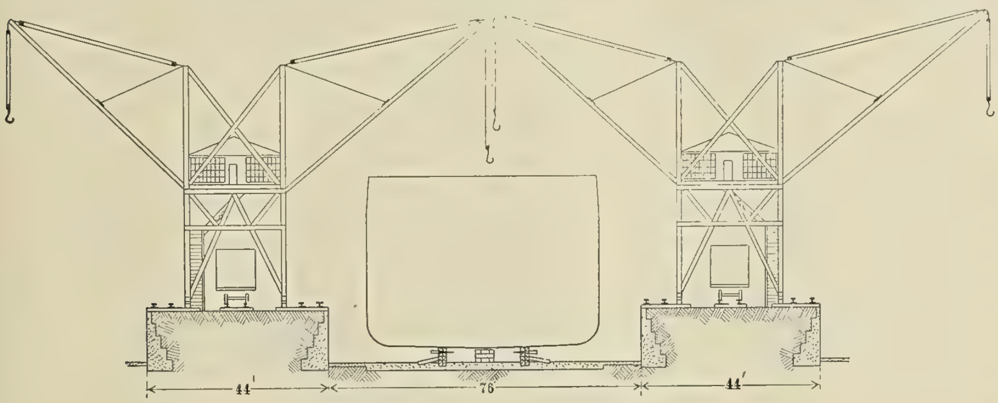


Fig. 6.—Cross Section of Shipway

especially arranged building for the storage of gas tanks and for the repair and storage of gas-burning and welding torches.

Shipways Built of Concrete

The shipways are of concrete construction on sand and rock foundations, with concrete retaining walls forming the sides of the docks between the ways. On each dock there are two wood derrick towers, movable on rollers, and each of the towers carries four derricks with 56-foot booms and electric hoists. It will be seen by the sketch, shown in Fig. 6, that the general elevation and profile of the property suggested this type of construction, the cost of which was less than that of the usual pile shipway above ground. The cost of maintenance will certainly be far less and the fire risk is reduced to the very minimum.

Adjacent to and facing the ways is the air tool storage and repair shop, where all air tools used on the ways and in the shops are stored and put in repair.

Power Requirements

Electric power, 11,000 volts, 3-phase, 60-cycle, alternating current, is purchased of the Tide Water Power Company and delivered by them to the transformers at the sub-station or power house shown on the plan. The power house equipment consists of an electrically operated switchboard, alternating current transformers, rotary converters for direct current, three electrically direct-driven air compressors, each of 2,275 cubic feet per minute capacity, and one electrically belt-driven air compressor of 1,200 cubic feet capacity per minute. The electrician's storeroom and workshop are located in this building. The building has concrete walls and concrete roof.

The storehouse walls and floor are of concrete with slow-burning wood construction roof supported on steel beams. It is 162 feet long, divided into ten separate fire-

Fig. 7.—Employees' Hotel at Carolina Shipyard; Housing Capacity, 150 Men

proof compartments by concrete cross-walls 16 feet apart, center to center.

Equipment of Machine Shop

The machine shop is 153 by 71 feet, of wood construction. While the principal engineering and mechanical equipment for the ships will be purchased outside, some machine shop capacity is provided for making corrections and alterations and for finishing many of the pieces of equipment that will be made in the yard. The machine shop equipment consists of six lathes of different sizes, two shapers, power saws, two radial drills and other tools of such a nature as to make the shop one of the most complete. There is also included a specially designed boring bar for the boring of the stern frames and tubes.

The pipe shop is equipped to fabricate all of the pipe work for the ships and contains, in addition to the hydraulic bending machine, pipe flanging machine and heavy cast iron bending floor, pipe cutting and threading machines and all other small equipment necessary for the handling of all sizes of pipe required on the vessels and in the plant. In addition, these shops will take care of all of the plant maintenance and upkeep work in their lines.

Blacksmith and Forge Shop

The blacksmith and forge shop is 181 by 60 feet, of wood and steel construction. The principal equipment is one 800-pound and one 1,100-pound steam hammer, and one 200-pound Bradley cushion hammer. In the same building is the sheet metal and wire working shop, with full equipment for the handling of all light pipe and sheet metal work required on the boats. In this building there is also located an electric galvanizing plant for galvanizing the many parts of the ships requiring this treatment. In another corner of this same building is the copper shop, equipped for the making of all copper piping and sheet copper work as may be required.

Separate from, but near the machine shop, is the pattern shop, which is replete with all necessary tools and equipment for the making of the finest patterns.

Carpenter and Joiner Shop

The carpenter and joiner shop is 136 by 46 feet, of wood construction, with tools and equipment to care for all ship carpenter work. The joiner work may be sub-let to other contractors, but if not, this shop will be equipped to do all of the work under that heading.

Other features are a 40,000-gallon steel tank on a steel tower 100 feet high. River water, used for fire protection and steam, is pumped to this tank by a duplex steam pump of 1,000 gallons capacity located in a fireproof building adjoining the boiler house on the river bank. The river water is fresh, and, except after a long, unusual drought, is excellent for steam purposes.

Adjoining the pump house, and also on the river bank, is the plant for making acetylene gas.

Outfitting Pier

The outfitting pier is 75 feet by 425 feet, of wood pile construction and wood decking. For heavy work there is a double stiff-leg derrick, each boom of a capacity of fifty tons. The light outfitting materials will be handled by locomotive cranes operating on the side tracks on the pier.

Welfare Features

The mess hall for the yard men is 240 feet by 57 feet, of wood construction. The west end is for the whites and will seat 1,025. The east end is for the colored and will seat 382. There are separate kitchens for each. The service is cafeteria.

The first aid hospital is 15 feet by 40 feet, of wood construction with concrete floors. It is equipped with two wards, an operating room and an office. The company carries its own insurance, and a surgeon and the accident manager are in attendance during working hours. Prompt service is given by the Walker Memorial Hospital of Wilmington, which maintains automobile ambulance service.

The time-keeping office at the eastern entrance has been used during the period of plant construction, but as soon as the trolley tracks are completed to the northern entrance the time-keepers will be established at that point, and that will be the entrance and exit used by all of the yard employees except the office force. Transportation service for the yard force will be to and from that entrance at the rush hours, but at other hours it will be to and from the eastern entrance. The former time-keeping office will then be used as a sub-station of the Wilmington post office, which has been established as a convenience for the shipyard and for the individuals employed there.

The restaurant for office employees is 62 by 24 feet, of wood construction. It seats eighty-eight.

The superintendents' office building is 32 by 71 feet, and in it are the offices of the outside foremen on ship construction and several others.

Located in the southeast corner of the enclosure is the locomotive house, 111 by 25 feet, of frame construction, for the housing and care of the company locomotives.

Administration Building

The administration building is U-shaped, 128 feet across the front, or north side, and each wing is 88 feet deep. The width of all the wings is 40 feet. On the first floor there is a hall 7 feet 6 inches wide running through the front and west wings, with offices on either side. The Fleet Corporation representatives occupy the entire east wing, first floor. The second floor contains the drafting room, covering the entire front wing, and the rest of this floor is devoted to offices, blue-print room and women's rest and retiring room.

Located near the administration building is a garage of frame construction 16 by 100 feet for the proper storage of the company cars, and immediately adjoining is the workshop where the cars are overhauled and kept in first-class repair.

The boiler house contains two 125-horsepower Erie boilers to furnish steam for fire pump, operation of steam hammers and blacksmith shop, and steam on the outfitting pier.

Employees' Hotel

The employees' hotel, just outside the fence, is of wood construction and has ninety-eight sleeping rooms, each 9 by 12 feet, opening on an outside porch, a living or assembly room 24 by 47 feet, quarters for the caretaker and his family, and tub baths, shower baths, toilets and washing fixtures. This is owned by the Fleet Corporation and will be operated by the shipbuilding corporation.

Domestic water for the entire plant is furnished by an artesian well 135 feet deep located in the shipyard.

The climate is ideal, never so cold as to interfere with out-of-doors work, and, while hot in the sun during the summer, it is very seldom that there is not a delightful breeze that overcomes the heat.

The Carolina Ship Building Corporation designed and built the entire plant with its own forces.

Type of Ships Under Construction

The present contract calls for the construction of twelve single-screw steel cargo vessels, to be built under special

survey to 100 A-1 Class of Lloyd's and constructed, equipped and fitted to meet all requirements of the United States Steamboat Inspection rules.

The general dimensions are:

Length between perpendiculars.....	395 feet 6 inches
Breadth, molded....................	55 feet
Depth, molded to shelter deck......	34 feet 11 inches
Height of between decks at side.....	7 feet 11 inches

The vessels are to carry 9,600 tons deadweight, including cargo, reserve feed water, fuel and stores, on a maximum draft of twenty-seven feet. They will be built on the Isherwood system of longitudinal framing and will have two complete steel decks with raised poop, bridge and forecastle.

There will be two steel cargo masts, with four 5-ton cargo booms on each mast, and one portable 30-ton boom installed for use on either mast. Two derrick posts, one on either side midships, will also be installed for handling coal for the large 'thwart-ship bunker. There will be four main cargo hatches, two forward and two aft, with four cargo winches located between each pair of hatches. There will also be one cargo winch on the poop and one on the bridge deck, which will operate the derrick post booms.

Hull Construction

A double bottom, 4 feet 3 inches in depth, will extend from peak to peak, the portion under the machinery space to be used for feed water and the portions fore and aft the machinery space to be used for either cargo oil or water ballast.

The coal bunker, which is directly forward of the fireroom bulkhead, will be twenty feet in length and will extend across the full width of the ship below the shelter deck. There will be additional coal bunker space between the shelter and bridge deck, which will bring the total capacity of bunkers up to 1,450 tons.

There will be five watertight bulkheads between the fore and after peaks. The peak bulkheads will be oil-tight, to allow these spaces to carry oil when necessary.

The stern frame is to be of cast steel in four sections: the rudder, one solid steel casting. Accommodations will be provided in the steel deck houses amidships for all officers', stewards' and cooks' departments. Accommodations for the crew will be under the poop deck aft. Under the forecastle deck forward will be the hospital, carpenter shop and rooms for paints, lamps, stores, etc. The chart room will be located on the flying bridge, with wireless room located in the after end. The refrigerating outfit, of two tons' capacity, and all necessary cold storage rooms will be located on the starboard side at the after end of the center house between the upper and shelter decks.

There will be one boat deck amidships, on which will be stored two 26-foot lifeboats and one metallic life raft for seventeen persons, as well as one 16-foot working boat. There will also be two 26-foot lifeboats on the poop deck. All lifeboats will be operated by the Steward mechanical davits and releasing gears.

Propelling Machinery

The machinery will be located amidships and will consist of one triple-expansion engine of 2,800 indicated horsepower and three watertube boilers equipped to burn coal and built for working pressure of 200 pounds, in addition to the auxiliaries necessary for this plant.

The electrical equipment will be cared for by two General Electric generators. The steam steering engine, with hand gear attachment, will be located under the poop deck aft and will be controlled from the pilot house by an electric telemotor.

The vessels and their machinery are designed for a sea speed of eleven knots. They will be constructed and fully equipped ready for sea at this yard.

Progress of Construction

The first four ships are now well along in their construction. The midship portion of the hull is being fabricated at Roanoke, Va., and while this portion is being erected the end sections are being fabricated at this plant. All of the work is progressing in such a manner as to warrant the launching of the first vessel about May 1, and the remaining ships should follow along at short intervals thereafter. As each vessel is launched she will be placed in the wet basin for the installation of machinery and final equipment, which will occupy about two months' time after launching for completion of each vessel.

Standard Sea-Going Cargo Vessel of 3,500 Tons Deadweight Built on the Lakes

(*Concluded from page 207.*)

sequence of cranks is high pressure, low pressure, intermediate pressure. The main condenser, which has a cooling surface of 1,562 square feet, is built into the engine framing. The main circulating pump is of the centrifugal type, with 8-inch suction and discharge, driven by a single-cylinder, 6-inch by 6-inch reciprocating engine. The air pump, attached to the main engine and driven off the low pressure crosshead, is of the Edwards type, with a capacity of about 5,100 cubic inches. Two 3½-inch by 20-inch single-acting feed and bilge pumps are also attached to the main engine and driven off the low-pressure crosshead.

The auxiliary pumps include:

One auxiliary feed, vertical duplex type, 7½ inches and 4½ inches by 10 inches.

One ballast, horizontal duplex type, 7½ inches and 8½ inches by 10 inches.

One fire bilge and general service, vertical duplex type, 7½ inches and 4½ inches by 10 inches.

One evaporator feed, horizontal duplex type, 3 inches and 2 inches by 3 inches.

One sanitary, horizontal duplex type, 4¼ inches and 3¾ inches by 4 inches.

One circulating pump for refrigerator coils and distiller, horizontal duplex type, 4½ inches and 3¾ inches by 4 inches.

One fresh water pump, horizontal duplex type, 4½ inches and 3¾ inches by 4 inches.

The auxiliaries also include a feed water heater; an evaporator designed to produce 15 tons of fresh water per twenty-four hours, using steam at not over 50 pounds pressure; an auxiliary condenser, and a feed filter.

Reinforced Concrete Steamer Armistice.—The first large self-propelled sea-going reinforced concrete vessel to be built in Great Britain, the *Armistice*, was launched by the Ferro-Concrete Ship Construction Company, Barrow-in-Furness, early in January. The vessel is a single-deck cargo steamer of about 1,150 tons deadweight, 205 feet long between perpendiculars, 32 feet beam, molded, 19 feet 6 inches depth, molded, and, with steam propelling machinery of about 400 indicated horsepower, is to have a speed of about 7¾ knots. The hull is built on the monolithic principle and has two holds with the machinery aft. The main engine is of the compound surface condensing reciprocating type, having cylinders 15½ inches and 33 inches diameter by 24 inches stroke supplied with steam at a working pressure of 140 pounds per square inch by two cylindrical boilers 9 feet 6 inches diameter by 9 feet long.

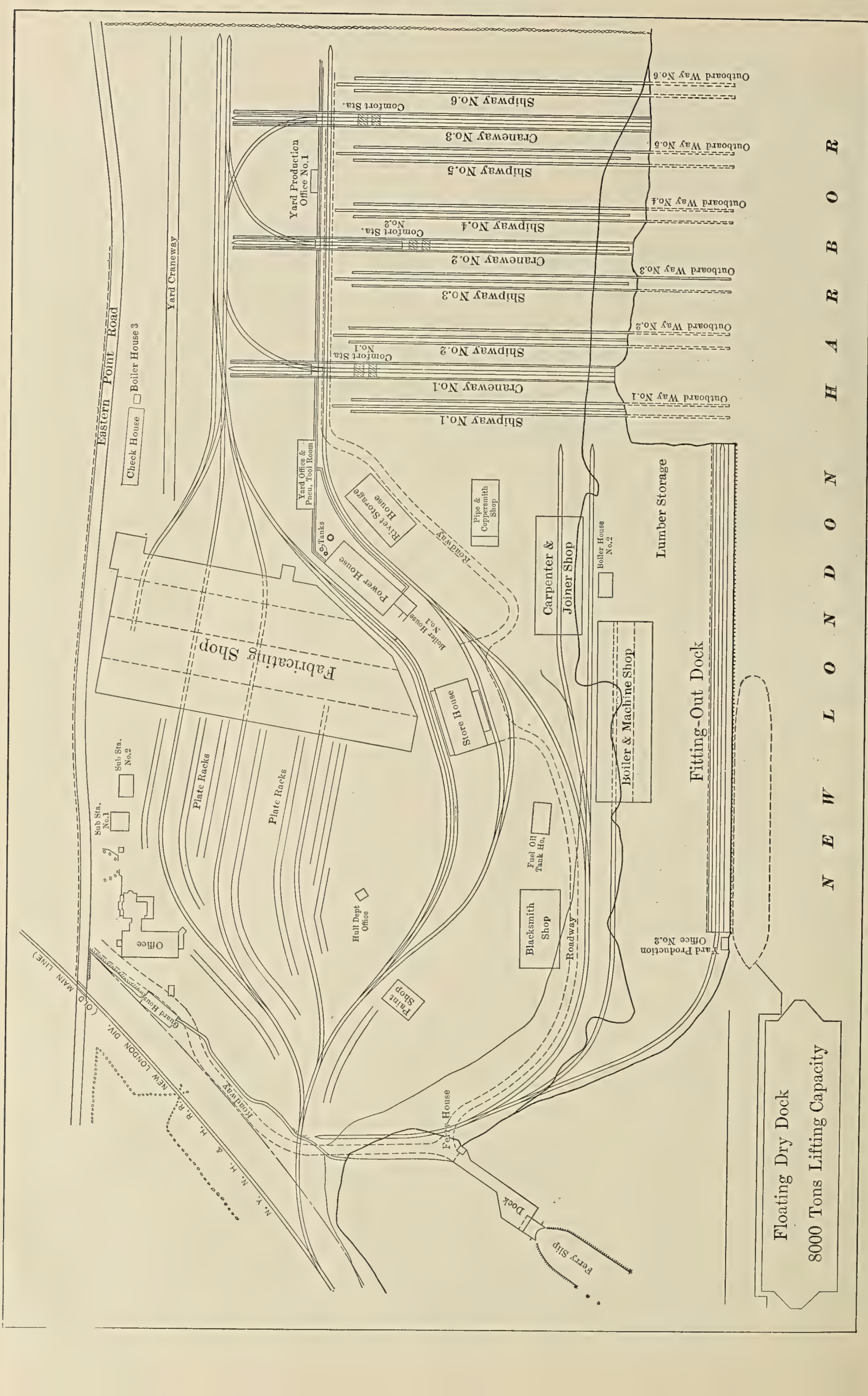


Fig. 1.—Plan Showing Layout of Groton Iron Works Shipyard

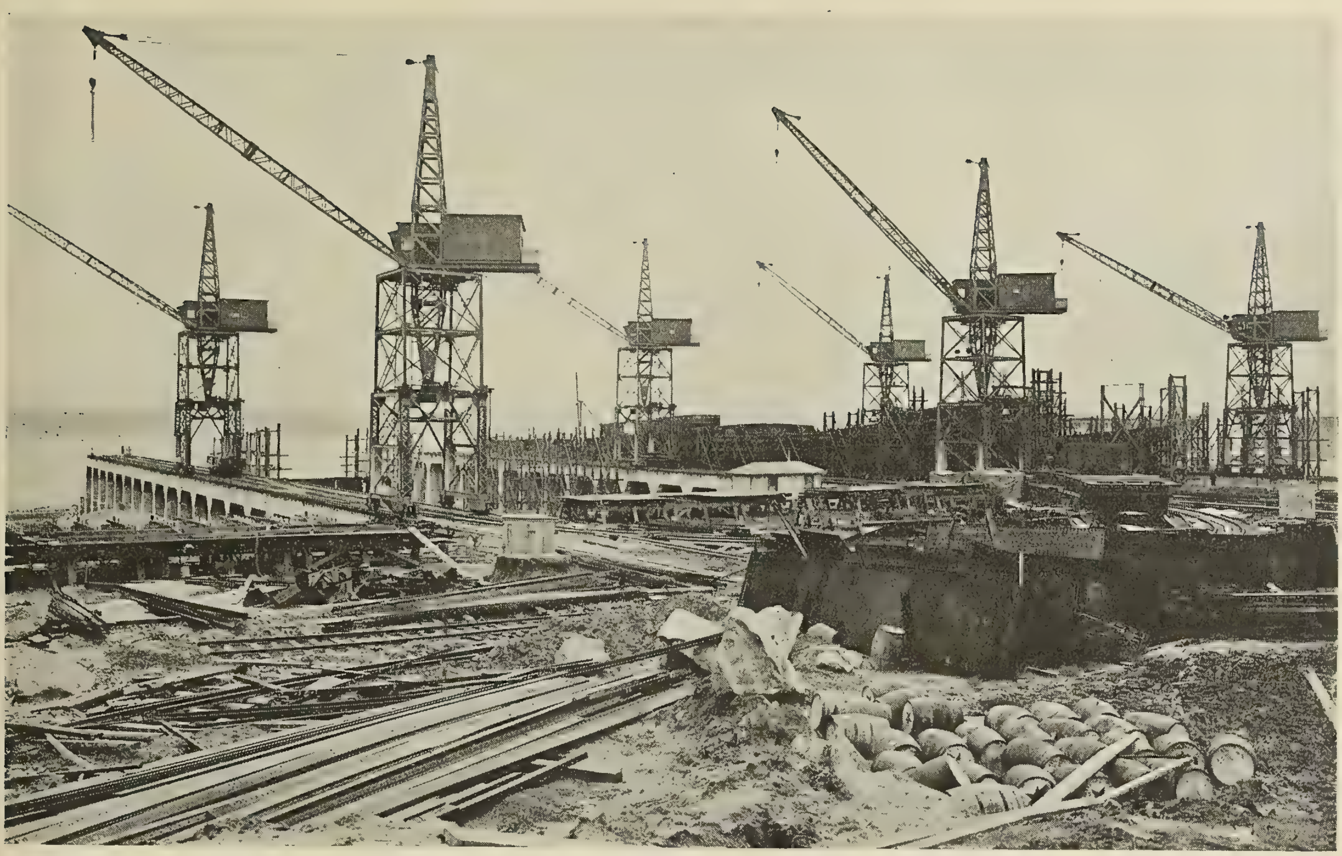


Fig. 2.—Six Terry Tower Cranes on the Three Concrete Craneways Handle Material at Shipways. Sub-Assembly Area for Bulkheads and Deck Houses in Foreground

Groton Iron Works Shipbuilding Plant

Latest Ideas Embodied in Layout and Construction of Modern Steel Shipyard—Six Launching Ways Provided

To meet the need for more ships, the Groton Iron Works, Groton, Conn., in April, 1917, purchased twenty-six acres near the mouth of the Thames River, opposite the city of New London in the heart of a summer colony, for the erection of a steel shipyard. This is an ideal location. A granite ledge runs about 6 feet below the surface of the ground and outcrops at the water's edge. The river at this point is 30 feet deep 800 feet from the shore, and 21 feet 200 feet from the shore, hence no dredging has been necessary for launching purposes.

The layout of the yard combines the best features of various yards throughout the country. Material enters at the north end of the yard from a spur of the New York, New Haven & Hartford Railroad to the storage yard and storehouses. There is a capacity for storing 18,000 tons of raw steel, or enough room for steel for six ships.

Method of Handling Material

The steel as needed is loaded by McMyler locomotive cranes on railroad cars and taken to the plate and angle shop to be punched. Here the steel is handled by Erie and Northern overhead electric traveling cranes to the laying-out tables and to the Lysholm tables for the punches, and again loaded on railroad cars. On these cars are built racks which carry plates in the center and shapes on the side. A greater weight can be carried in this way, and it is possible then to pick out the piece wanted first when the car arrives at its destination. The steel then goes to finished steel stores or to ground assembly spaces or direct on the craneway for erection.

Concrete Shipways

The yard has three concrete craneways and six end-launching concrete shipways. The shipway consists of a central keel blockway and two launching ways; all are of concrete rectangular cross section built on ledge rock. The ways have a slope of ⅝ inch to the foot. Each of the six building ways can now take vessels up to 450 feet long and 60 feet beam. All ways can easily be lengthened to take 500-foot ships.

There are six Terry hinged-boom traveling revolving tower cranes now in operation on the craneways. These cranes are capable of lifting 5 tons at a radius of 87 feet and 13 tons at 52 feet at a speed of 65 and 48 feet per minute, respectively. One complete revolution is made in 1½ minutes. The travel speed is 250 feet per minute.

In testing the cranes, loads 25 percent in excess of those specified were used. The booms are constructed of structural steel shapes and are of the locomotive crane type, approximately 7 feet wide at the base.

The structural steel masts are equipped at their lower ends with the Terry hemispherical mast step and foot blocks, designed to develop the resultant horizontal and

Fig. 3.—Showing Ground Assembling of Shaft Alley

vertical forces at this point. Some of the cranes have a tower 53 feet high, others 68 feet, and are designed for running on rails 18 feet center to center, with a portal providing 20 feet vertical clearance.

The upper ends of the towers are equipped with cast steel ring gears machined on their inside to take the thrust of the mast rollers. The bottoms of the towers are fitted with eight M. C. B. cast iron double-flanged chilled tread wheels 28 inches diameter arranged in pairs.

The main falls are composed of four parts of ⅝-inch 6 by 19 plough steel rope reeved through one 14-inch single metaline bushed block with shackle, and one 14-inch double metaline bushed block with swivel hook and cheek weight for overhauling. The boom falls are of seven parts of ⅝-inch 6 by 19 plough steel reeved through two 14-inch triple metaline bushed blocks with shackles.

The main hoists are equipped with a 65-horsepower, 230-volt, direct-current General Electric motor of the double-friction drum type with band brake and non-reversing mechanical brake. The swingers are equipped with 15-horsepower, 230-volt, direct-current motors driving through proper gear reductions. They are equipped with solenoid brakes.

The crane travel drive is equipped with 65-horsepower, 230-volt, direct-current motors with proper gear reductions and solenoid brakes. The controls are so placed as to give the operator a clear view of his work at all times, banked in a quadrant. The approximate weight of each crane is 215,000 pounds.

Ground was broken for the construction of the Groton plant in August, 1917. On August 11, 1917, a contract was signed with the United States Shipping Board Emergency Fleet Corporation to build six steel cargo steamers of 8,800 deadweight tons each. These vessels are of the *Robert Dollar* type, with length overall 423 feet 9 inches, beam (molded) 54 feet, depth (molded) 29 feet 9 inches, load draft 24 feet 1 inch, speed 10½ knots. They are built on the longitudinal framing or Isherwood design.

On April 20, 1918, another contract was signed for six

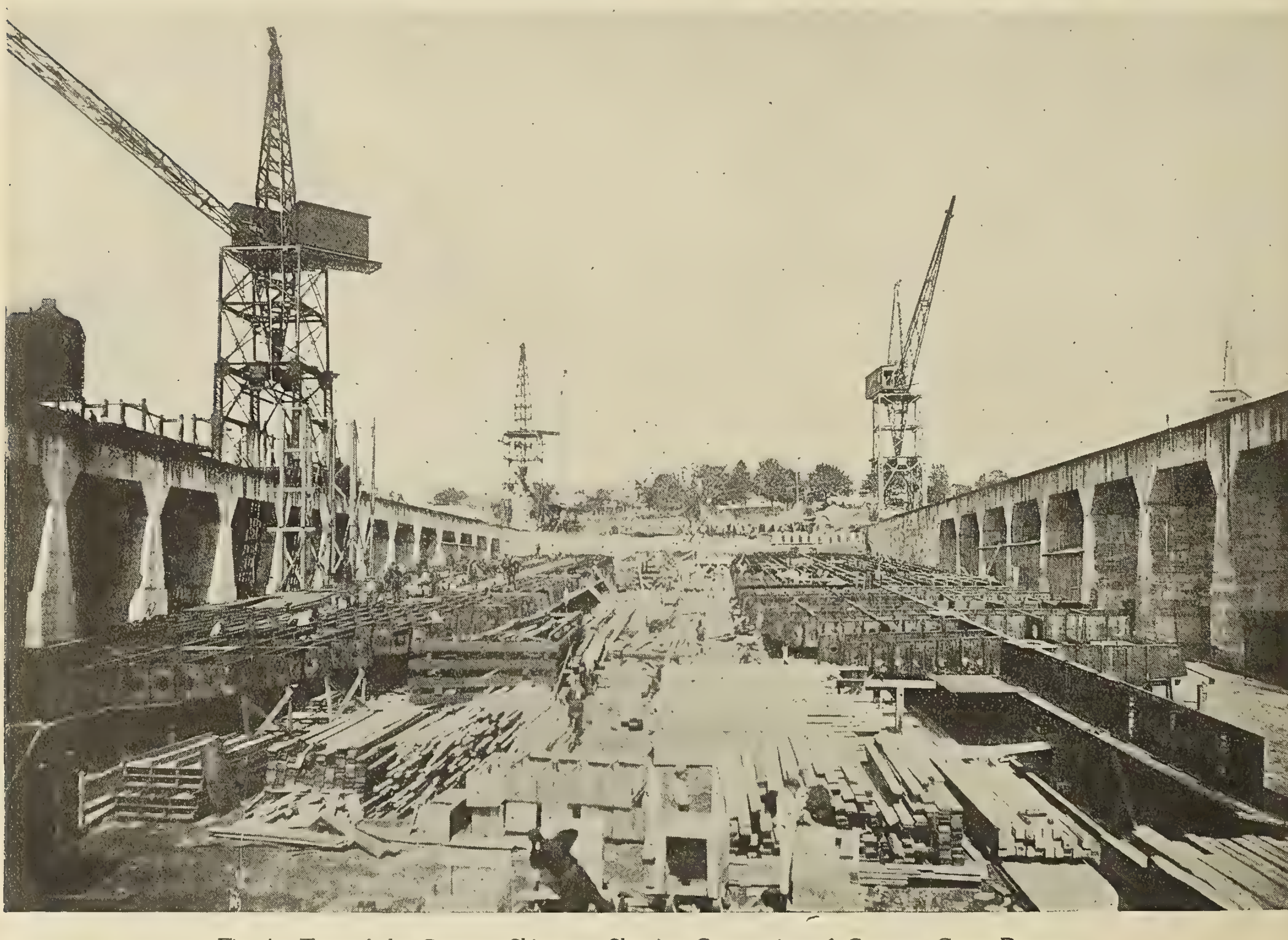


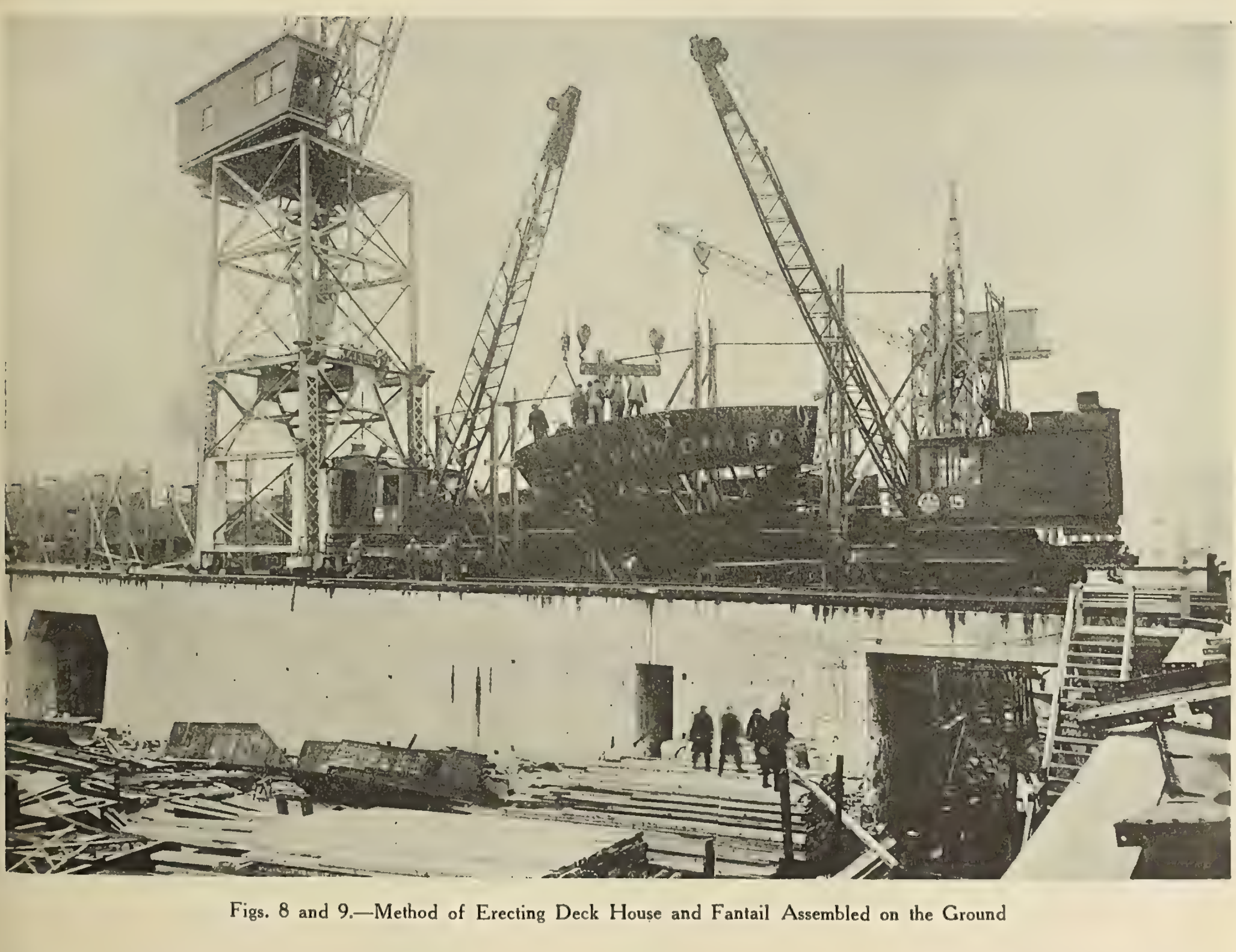
Fig. 4.—Two of the Concrete Shipways, Showing Construction of Concrete Crane Runways

SHIPYARD OF THE GROTON IRON WORKS, GROTON, CONN.

Plant Has Six Concrete Shipways and Is Building Cargo Steamships of 8,800 and 9,400 Tons Deadweight

Fig. 5.—Waterfront of Groton Iron Works, Showing Building Ways, Fitting Out Berth and Shops

Fig. 6.—South End of the Yard, Showing Concrete Construction of Shipways and Shipway Crane Runways



Figs. 8 and 9.—Method of Erecting Deck House and Fantail Assembled on the Ground

additional ships of the Isherwood type of 9,400 tons deadweight capacity; length overall 417 feet 3 inches, beam (molded) 53 feet, depth (molded) 26 feet 6 inches, load draft 26 feet 4¾ inches, speed 10½ knots.

Record Construction

The keels of seven ships have been laid, the first one January 28, 1918. The first ship was launched November 9, 1918. For a new yard to get its first ship off the ways in less than ten months is an accomplishment that speaks well for the ability and facilities of the builders. Besides

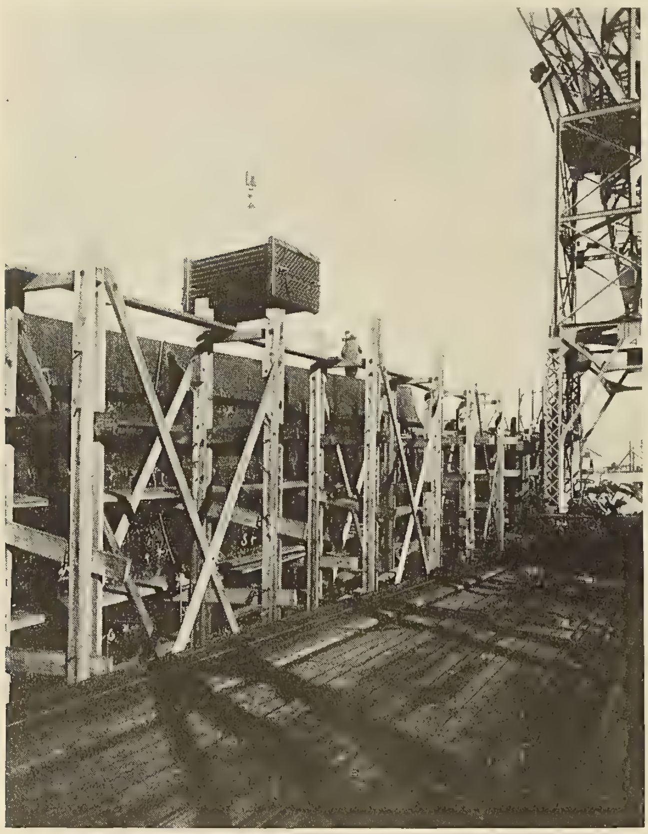


Fig. 10.—Placing the Boilers Aboard Long Before the Ship Is Launched

the work necessary and ordinarily required before launching, the following items are installed: Boilers, condensers, windlass, winches, main engine and auxiliaries, deck houses and fresh water tanks.

It is the policy of this company to do as much preassembly work as possible. For instance, the fan tail includes not only the transom and cant frames, but also part of the poop deck and the knuckle plates and shell on the counter. The deck house is placed on the ship complete.

The sizes of some of the principal buildings in the plant are as follows: Plate and angle shop (equipped with three "bull" riveters), 450 feet by 200 feet; mold loft (over plate and angle shop); boiler and machine shop, 300 feet by 80 feet; joiner shop, 170 feet by 70 feet; main stores, 150 feet by 60 feet; rivet stores, 100 feet by 50 feet; blacksmith shop, 120 feet by 60 feet.

Living conditions in New London are very congested, but are continually becoming improved. In this vicinity the Government has located a submarine base, an experimental station, Coast Guard defense and other activities. In spite of all this the number of employees has been increased 50 percent within the last two months. A training school under the Emergency Fleet Corporation is in full operation and is turning out reamers, shipfitters, riveters, bolters-up, chippers and calkers to meet the needs. The total number already trained is 170, and those under instruction now total 150.

The Employment Department is very much alive and does everything possible to keep the men interested and have them especially feel that this is their yard. The *Morse Code*, a semi-monthly paper, keeps everyone informed of what the other fellow is doing. An athletic team is formed in nearly every known sport, and great pride is taken in the band.

The company's organization is complete. As the superintendents and foremen are all men of long shipbuilding experience and among the foremost shipbuilders of the country, this yard should be one of the best shipyards on the Atlantic Coast.

Some Aspects of Large Diesel Cargo Ships

(*Concluded from page* 219.)

ment of this new industry, the importance of which is likely to reflect itself very pronouncedly in the future industrial and economical life of the nation.

In conclusion, certain tendencies which have recently made themselves felt regarding the method of drive for motorships call for some remarks here as far as this applies to heavy-duty work. Under the old, and, as usual, superficial one-sided arguments of lightest possible weight, the use of high-speed Diesel engines is recommended, combined either with reduction gears or electric drive; the latter, particularly, is supposed to be possessed of considerable advantages. As a matter of historical fact, it may be stated that the idea of Diesel electric drive is almost as old as the direct-reversible engine and has in at least two entirely independent cases been thoroughly tried out, with results which are quite evident to-day. The method has not been discarded so much on account of inherent difficulties as on account of failure to disclose any advantages, if combined with engines suitable for cargo boat service.

In every Diesel engine the rotative and piston speeds are fundamental quantities as well as qualities; they must satisfy not only given requirements as to output, but likewise bear a close relation to the life of the engine. The service to be rendered at once sets certain limits upon these speeds, and it is quite evident that steady operation under heavy loads demands lower speeds than where durability is sacrificed in favor of minimum engine weight and space. Continuity of operation and long life, aside from a favorable piston speed, dictate more liberally proportioned connecting rods and pistons than what is customary in high-speed engines, which means higher and stiffer frames and heavier cylinders. The reciprocating parts thus becoming heavier, more substantial proportioning of the crank shaft and bearings is the next desideratum. The rotative speed, partly dependent upon the weight of the reciprocating parts, must be kept within reasonable limits, as it also determines the very important relation of periodicity and reversal of stresses.

With all these points given due consideration, the installation of suitable Diesel electric sets cannot be accomplished within anywhere near the space or weight now required by high-grade, direct-reversible, low-speed engines directly connected to the propeller shaft. Owing to their mechanical simplicity, ease of operation, superior fuel economy and very materially lower cost, these are and continue to be the ideal solution for cargo boat propulsion.

Fig. 1.—Laying the Keels for Steel Vessels at the Plate Yard

A Southern Shipbuilding and Repair Plant

Shipyard and Repair Facilities of the Alabama Dry Dock & Shipbuilding Company—Methods Employed in the Yards

BY G. F. S. MANN, B. S.

THE Alabama Dry Dock & Shipbuilding Company, Mobile, Ala., was formed in January, 1917, by Mr. D. R. Dunlap, the president. It was his intention to devote the activities of the company to a task which is of equal importance to shipbuilding in war times, namely, the repairing of ships. As a matter of fact, the company is building some ships for the Government, although its main energies are still being devoted to the repairing of ships.

The plants formerly owned by the Ollinger & Bruce Dry Docks Company, the Gulf Dry Dock Company, the Alabama Iron Works and the Gulf City Boiler Works have been united, and a large addition has been made to the company by the building of a complete unit on Pinto Island, where formerly there was only a 4,000-ton floating dry dock. At this point Pinto Island forms the east bank of the Mobile River. The property of the Alabama Dry Dock & Shipbuilding Company extends, with interruptions,

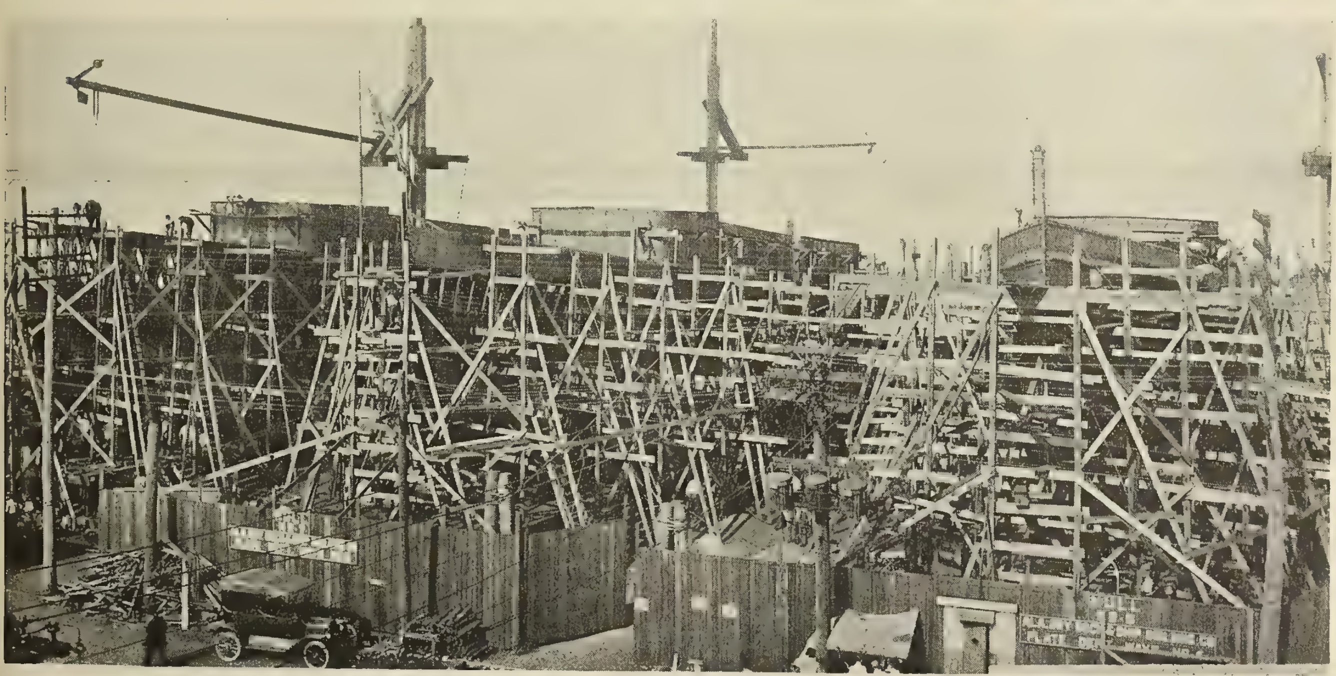


Fig. 2.—Steel Hulls Under Construction

A SOUTHERN SHIPBUILDING AND REPAIR PLANT

Alabama Dry Dock & Shipbuilding Company, Mobile, Ala.

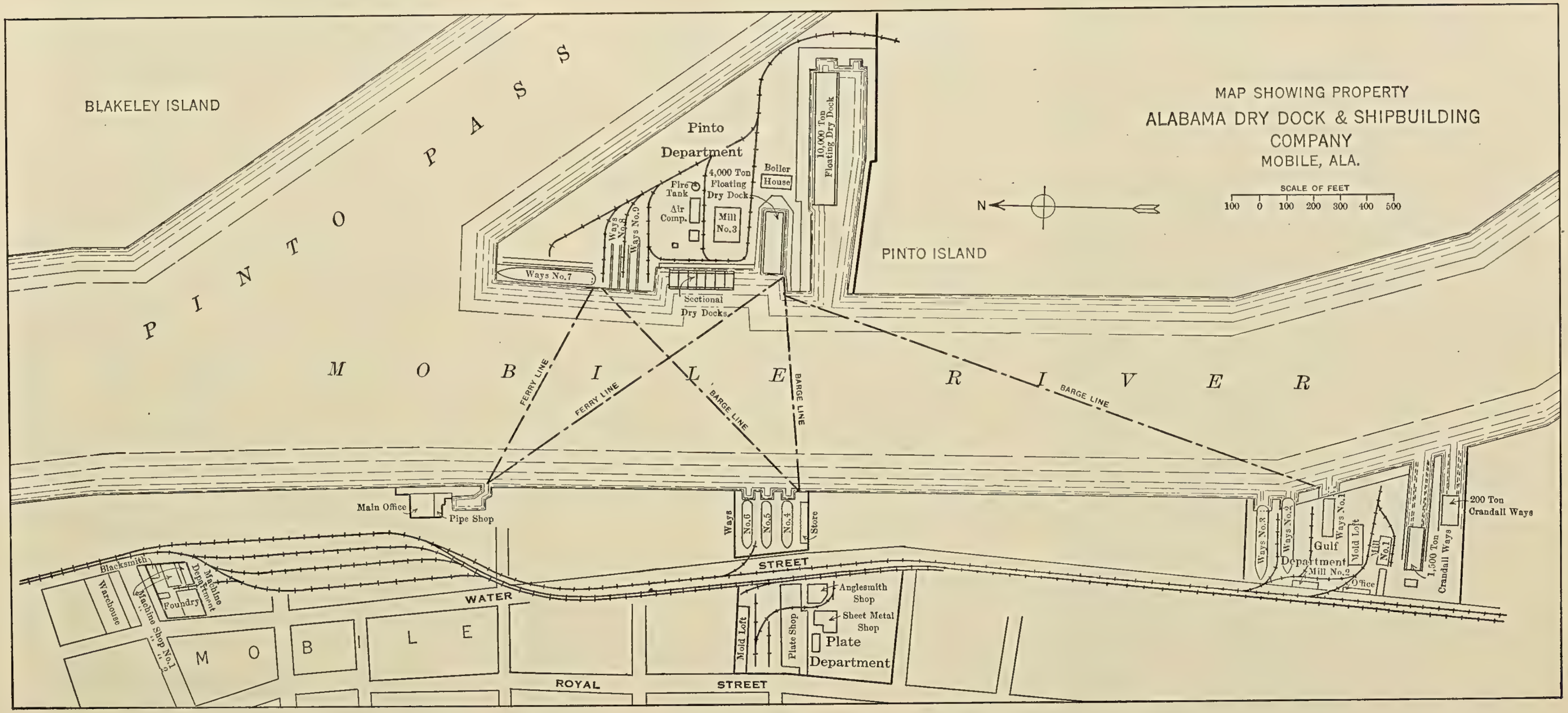


Fig. 3.—Map Showing Location of Separate Plants and Railroad and Ferry Connections

for about a mile along the west bank of the Mobile River. The buildings and equipment formerly owned by the Alabama Iron Works are at the north end of the property and are the machine shops, blacksmith, foundry and pattern shops of the present amalgamation.

A short distance south of the machine department is the new general office building, containing the president's offices, the engineer departments and the auditing and accounting offices. At this point is a wharf 327 feet long, and from it passenger service is maintained to Pinto Island by motor launches. Here also is located the pipe-fitting shop of the company, and ships are moored at this wharf for finishing after the boilers and engines are installed. About three hundred yards south of the main office is the plate department, where the Gulf City Boiler Works formerly operated. This department has been very materially enlarged by the addition of a mold loft, a fabricating shop, an anglesmith shop and three building ways. Part of the outfitting of ships is done at this point. The plate superintendent's and electrician's offices are located here, as this is the most central part of the plant.

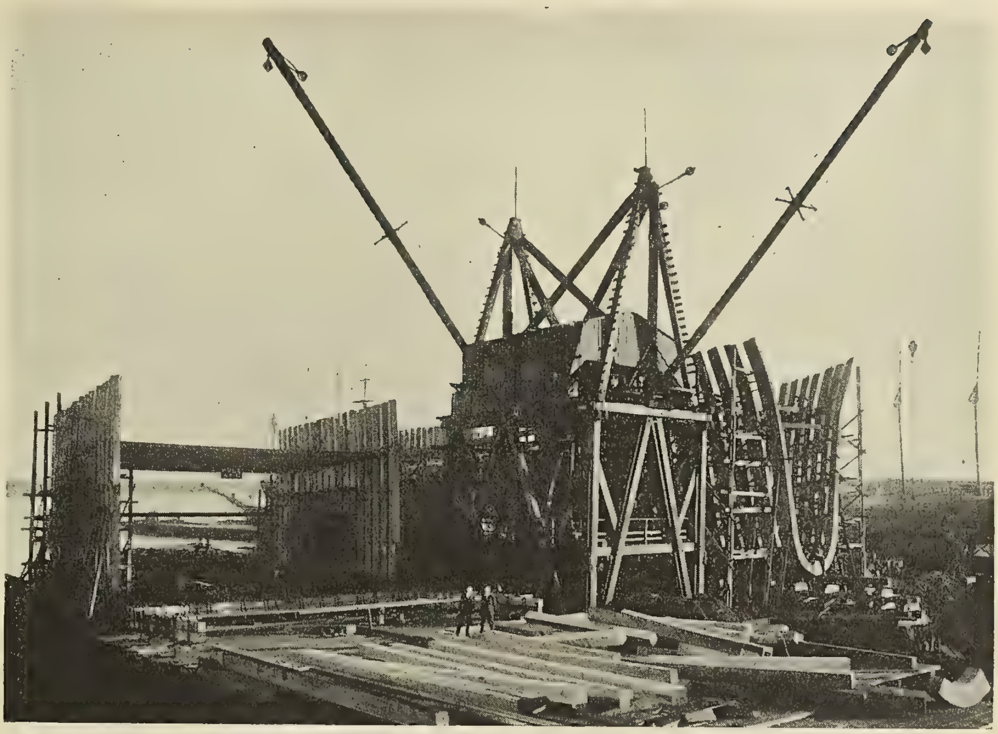


Fig. 4.—Wooden Hulls Under Construction at Gulf Department

THE GULF DEPARTMENT

At the extreme southern end is the Gulf department, which is an enlargement of the Gulf Dry Docks Company property. At this point wooden hulls are built and outfitted. There are also two Crandall marine railways, the larger having a capacity of fifteen hundred tons.

On Pinto Island, which one year ago was a sand dune, are now three dry docks, a machine shop and a 360-foot building berth, in addition to two smaller sets of building ways.

The machinery department is now equipped to make any kind of repairs and to build engines. Castings up to three tons in weight have been poured in the foundry, which has two seven-ton cupolas. This department has made most of the parts for three 1,400 indicated horsepower engines and installed them in the hulls built by this company. As far as the writer knows, this is the only company on the Gulf which has built marine engines.

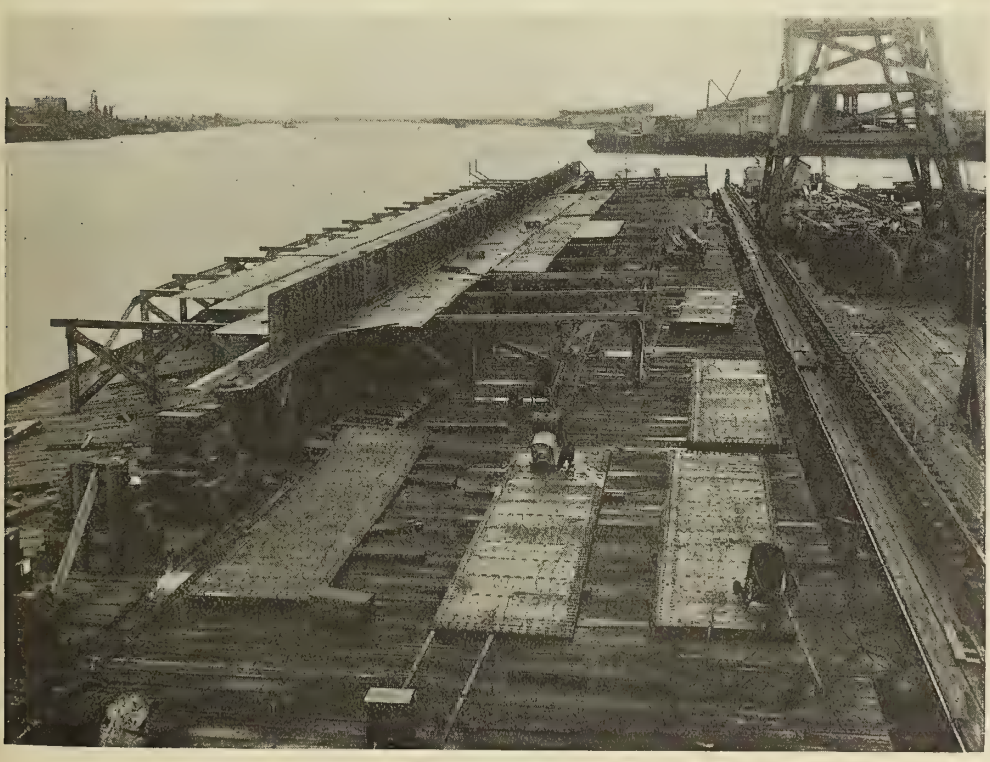


Fig. 5.—Panama Barge, Hull No. 9

In the plate department have been built the hulls of three mine sweepers and also one steel barge of 7,500 tons deadweight for the Panama Canal Commission. This necessitated the handling of about twenty tons of structural steel a day through the plate shop. The steel for the Panama barge was ferried across the river to Pinto Island, where this vessel was built on a side-launching way.

In the Gulf department have been built two wooden steamers of 3,500 tons deadweight each. Most of the pontoons for the 10,000-ton floating dry dock were built here. On the Crandall marine railways numerous

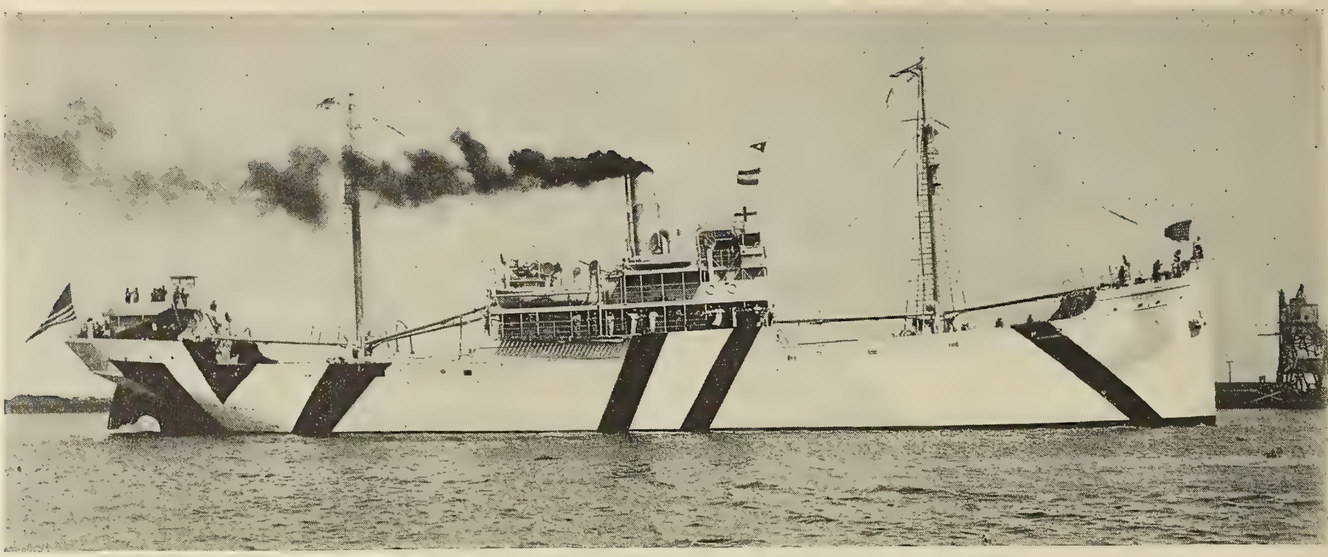


Fig. 6.—S. S. *Banago*, Built by Alabama Dry Dock & Shipbuilding Company

small vessels have been overhauled, painted and repaired.

Pinto Island has been the main department for dry docking and repairs. Ferry lines run to it from all other departments. On the north end of the island the first Panama barge is being built and another one is to be built here. Some pontoons were built in this department for the 10,000-ton dry dock. At the south end of the company's property on this island has been dredged a slip 895 feet long by 216 feet wide and 40 feet deep for the 10,000-ton dry dock. This dry dock is built in two sections, so that either one may be used independently for lifting 5,000 tons weight. Directly north of this is the 4,000-ton floating dry dock formerly owned by Ollinger & Bruce, and still farther north is a 1,000-ton sectional floating dry dock. A large mill, forge and woodworking shop have been erected, and also an air compressor. As the island is not connected with the city water supply, a 30,000-gallon tank has been put on an 85-foot tower for fire protection purposes.

During 1918, over 130,000 tons of ships were dry docked and about 750,000 tons of ships have been repaired. One of the most interesting pieces of work done here was the fitting out of the S. S. *Lucia* with air chambers to make her unsinkable. Details of the work were described by W. T. Donnelly, consulting engineer, New York, before the Society of Naval Architects and Marine Engineers at its last annual meeting.

There are two ways of handling material from one de-

Fig. 7.—Mold Loft at Plate Department

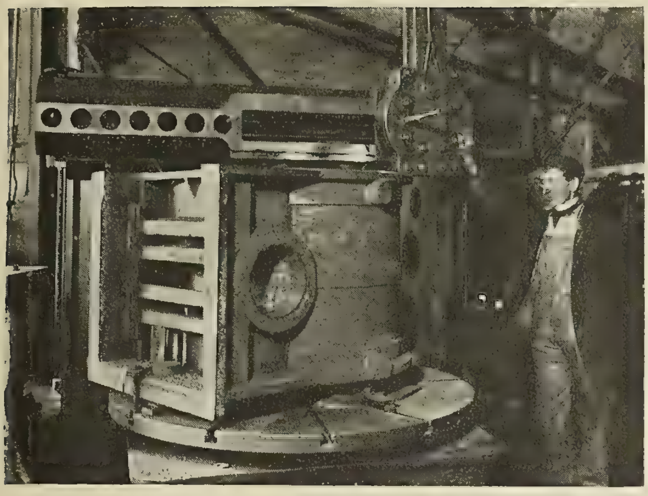


Fig. 8.—Machining an Engine Cylinder in the Machine Shop

Fig. 10.—Pouring a Casting in the Foundry

partment to another on the mainland, namely, by railroad and by motor trucks. The company uses the Louisville & Nashville Railroad main line from the north end of the plant to the south, sidings running into each department. Parallel to this railroad are Water and Royal streets, along which motor truck service is maintained. Steel is carried in the yards, and from the plate department to the ferry and construction ways by electric trucks.

The wooden ships and the mine sweepers were served by stationary derricks, but the Panama barges are being built with the aid of a traveling tower whirler. At conspicuous places in the yard are placed boards with movable models of each ship attached to show the progress that is being maintained on the construction. This has been found to stimulate the interest of the different gangs of workmen building the various hulls, and has a good effect in creating competition among them.

Improvements in Ship Construction.—In a paper read before the Institution of Engineers and Shipbuilders in Scotland, E. F. Spanner, R. C. N. C., proposes a new method of providing a central pipe or duct in the lower portion of a vessel for the purpose of dealing with fluid distributed in different compartments along its length. In this particular development it is proposed to provide the central fore-and-aft duct by dispensing with the ordinary vertical keel plate and by working instead a relatively narrow box keel running the length of the vessel and having an uninterrupted passage through it from one end to the other. It is claimed for this duct-keel system that not only it is possible to eliminate practically the whole of the pipes forming the ordinary filling and suction systems, but also that practically the whole of the heating pipes can be dispensed with. In the case of a vessel burning coal and using the double-botton tanks primarily for the carrying of water ballast, the provision of the duct keel enables virtually the whole of the ballast suction system to be dispensed with, while no holes are necessary through watertight bulkheads. Further, water entering the ship following damage cannot find its way along the ship to other undamaged compartments by way of the keel duct except under the control of the ship's officers through the system of valves which is installed.

Fig. 9.—10,000-Ton Dry Dock Pontoons Nos. 3, 4 and 5

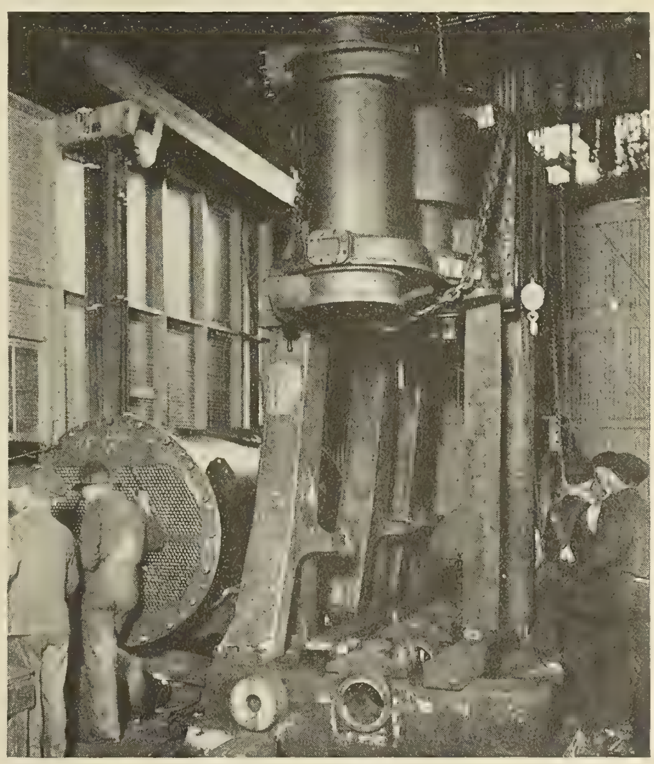


Fig. 11.—Lining Up an Engine in the Machine Shop

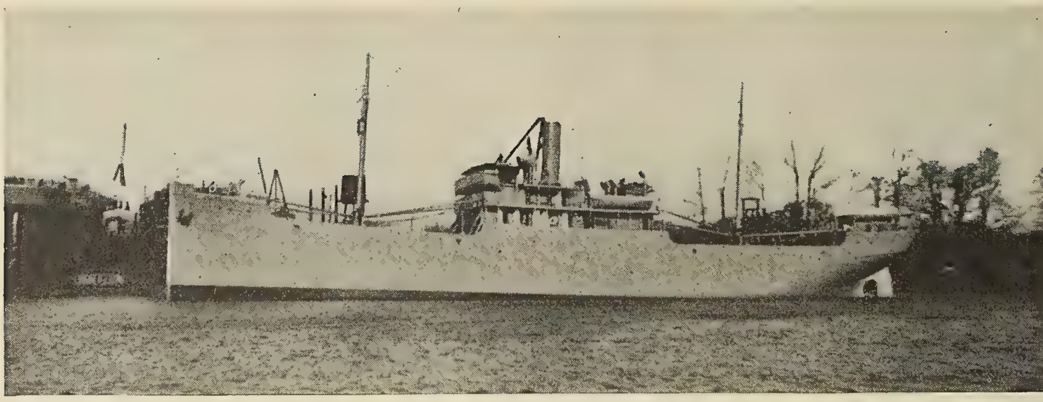


Fig. 1.—S. S. *Daram;* Hull 181; Fifth Ship Built at the Traylor Shipyard

Large Wooden Shipyard on the Delaware

Traylor Shipbuilding Corporation Organized to Build Wooden Ships for the Emergency Fleet—New Yard Erected at Cornwells, Pa.

BY R. R. SHAFTER*

IN April, 1917, the Traylor Engineering & Manufacturing Company, Allentown, Pa., secured a contract from the United States Shipping Board for ten 3,500-ton, "Ferris" design, wood cargo-carrying steamships, complete, including the installation of all propelling machinery, deck machinery, etc. At that time this was the only contract placed for a complete wooden ship with an Eastern concern.

Negotiations for the purchase of the plant and property of the Enterprise Manufacturing Company at Cornwells, Bucks County, Pa., on the Delaware River, sixteen miles north of Philadelphia, were consummated, and the Traylor Engineering & Manufacturing Company, in the month of April, 1917, took over the property and organized the Traylor Shipbuilding Corporation, to which concern this contract was assigned. This property consists of approximately ninety acres of ground from the river to the main line of the Pennsylvania Railroad, a distance of approximately 3,250 feet, with a river frontage of approximately 1,200 feet. A State highway from Philadelphia to Trenton, parallel to the river, runs through the property to the north of the main shop buildings and about 1,200 feet from the river.

On the property were three concrete buildings—one a mill building 105 feet wide by approximately 700 feet long, a power house 40 feet wide by approximately 110 feet long, and another building, which was later turned into a mold loft, approximately 60 feet wide by 210 feet long, together with an anthracite gas producer building and a partly covered crane runway about 1,100 feet long. In addition to all this, there is a canal about 55 feet wide running

* General superintendent, Traylor Shipbuilding Corporation.

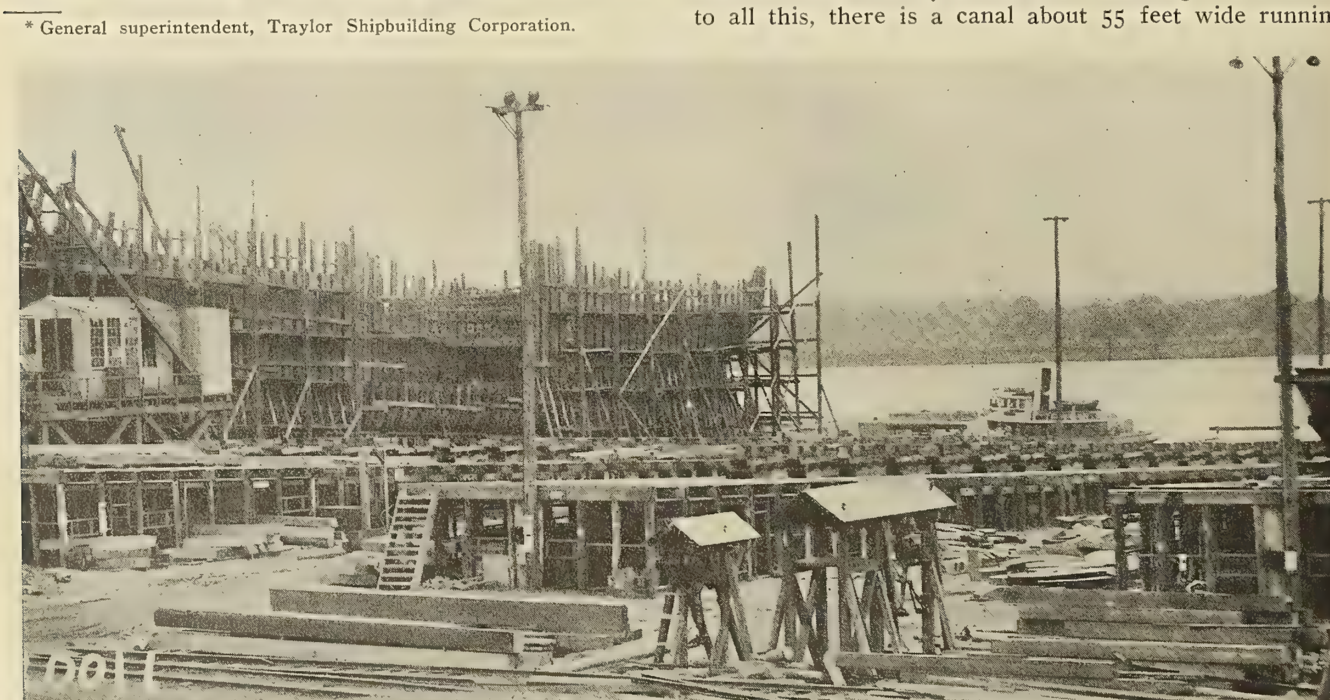


Fig. 2.—Partial View of Shipways, Showing Vessels in Frame

Fig. 3.—One Ship Ready for Sea Trial; Another Being Fitted Out, and Another Just Launched

from the river to the State road to the east of the property, a length of approximately 1,000 feet, and about one mile of railroad sidings and tracks.

Preliminary Construction Work

About the middle of May, 1917, actual work was started of cleaning out the old machinery in the large mill building. Overhauling of the power plant equipment was started at the same time, and the cleaning of the river front was started for the construction of the shipways and tracks.

While this preliminary work was going on, an organization was being formed known as the "Traylor Shipbuilding Corporation," and plans were being made of turning this property into a shipyard for the building of the wooden ships, with a view of speedy completion with the least possible expense. Up to about the middle of June, 1917, we had no interference of any kind from any Government men, but about that time a resident inspector for the Shipping Board was placed at the plant, from whom the Traylor Shipbuilding Corporation was to get authorization for the expenditure of money, as the Shipping Board, according to contract, was to pay for all plant improvement and equipment installed on the property.

The original plans showed ten shipways, and material was ordered for the ten ways, but after five were completed work was shut down on the other five, which were practically completed with the exception of that part of the ways out in the river under high tide. As for these five ways, it was found that piles could not be driven out in the river on account of a ledge of rock. Admiral Bowles, who was assistant general manager of the Emergency Fleet Corporation at that time, refused to allow the

Fig. 4.—Erection of Frames

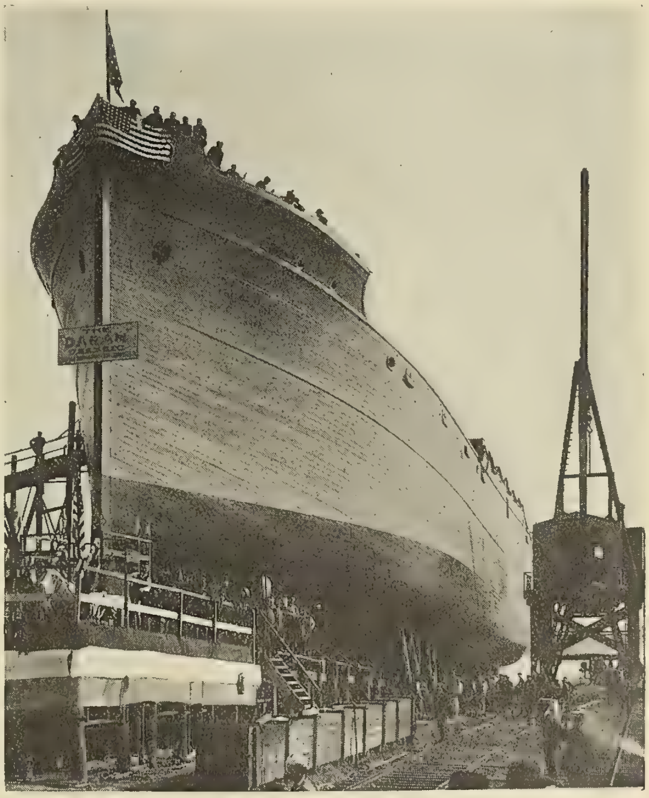


Fig. 5.—Hull Ready for Launching

finishing of the last five ways, as he felt that a sufficient quantity of lumber, as well as a sufficient number of shipbuilders could not be secured for working ten shipways at one time.

Laying the First Keel

Practically a whole year was required to finish and complete the entire shipyard with all improvements, but just as soon as a shipway was ready for the laying of a keel the keel was laid. Consequently, the keel for the first boat, known as Hull 177 (S. S. *Alvada*), was laid on September 27, 1917; the keel for the second boat, Hull 178 (S. S. *Alapaha*), was laid on November 13, 1917; the keel for the third boat, Hull 179 (S. S. *Buhisan*), was laid on December 20, 1917; the keel for the fourth boat, Hull 180 (S. S. *Bulana*), was laid on December 24, 1917, and the keel for the fifth boat, Hull 181, (S. S. *Daram*), was laid on December 26, 1917. Thus the five shipways which we were permitted to use had keels on them before the first of the year 1918. Keels could have been laid earlier, as the shipways were ready before the actual time of keel laying, but the delivery of the lumber by the Shipping Board was very slow. It may be mentioned that at that time the United States Shipping Board undertook to supply all materials entering into the construction of these ships.

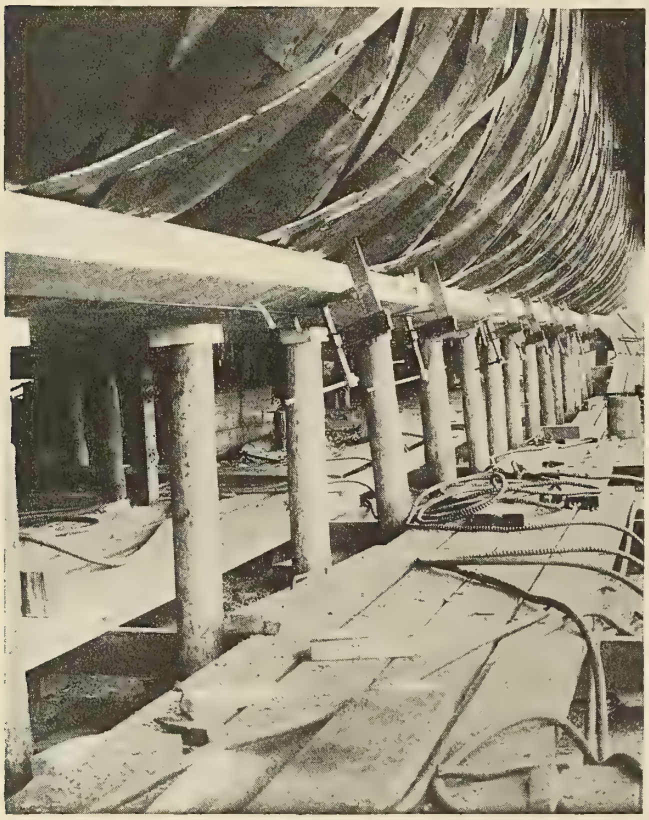


Fig. 6.—Bilge Construction, Showing Method of Planking. Note Steel Straps Across Frames

Work on the first boat went along very slowly, but with caution, as detailed drawings for the construction of these ships were not supplied at that time by the Shipping Board, with the exception of a general drawing and profile, and it was up to the naval architect and staff of the Traylor Shipbuilding Corporation to make all details and develop them on the mold loft floor, from which molds were made for the various timbers. Considerable delay and annoyance were caused by the continuous changes in design made by the American Bureau of Shipping and the Shipping Board.

Building Schedule

The first frame on the first ship was hoisted in position and fastened to the keel in October, 1917, by one of the traveling wooden gantry cranes which the company built for the handling of all material to the ships while under construction on the ways. The large floor timbers for frames for the ships, which are 12 inches by 26 inches by 30 feet long, did not arrive at the yard until the middle of February, 1918, so little work could be done on the ships for which keels were laid, except as regards the stem and stern construction and fore and aft cant frames. As an instance of this delay, the keel for the first ship was laid in September, 1917, but actual work in volume could not be done on the ship until the middle of February, 1918, when heavy floor timbers arrived. After that date progress was shown, and during the months of April and May such speed and progress were developed that on June 1 Hull 177, the *Alvada*, was launched. From then on boats were launched in rapid succession, and up to this writing (January 31, 1919) the following is the schedule of launchings and deliveries of completed ships to the Shipping Board:

Hull No.	Name of Ship	Launching Date	Delivery Date
177	*Alvada*	June 1, 1918	August 20, 1918
178	*Alapaha*	July 4, 1918	September 21, 1918
179	*Buhisan*	August 17, 1918	October 28, 1918
180	*Bulana*	September 2, 1918	November 21, 1918
181	*Daram*	October 19, 1918	December 19, 1918
182	*Tanka*	December 18, 1918	January, 1919

This leaves four ships still to be launched and four ships to be fitted up. The possible launching and delivery dates of the balance of the vessels are as follows:

Hull No.	Name of Ship	Launching Date	Delivery Date
183	*Oraton*	February 5, 1919	March 10, 1919
184	*Seypen*	February 25, 1919	March 25, 1919
185	*Albriton*	March 20, 1919	April 20, 1919
186	*Allerton*	April 15, 1919	May 15, 1919

During the spring of 1918 a wooden wharf or fitting-out dock was built at the head of the canal, where the ships are moored for fitting up.

Considerable time elapsed between the launching of the first hull on June 1 and delivery of this ship on August 30 on account of the non-arrival of machinery and equipment supplied by the Shipping Board. The same held true with the second ship, launched on July 4 and delivered on September 21, as well as the third ship, launched on August 17 and delivered on October 28; but after that date material arrived in better shape, and it was possible to catch up with launching dates, so that a ship was launched and a ship was delivered every month, each ship being delivered a month after it was launched.

Gantry Cranes

The gantry cranes, one between each shipway, are of the traveling type, with a stiff leg mounted on a high platform, operated by a steam engine. These gantry cranes have given wonderful service, and the cost of upkeep has been very small indeed for the class of work they performed. They are of five-ton capacity and can reach any part of the ship with a load. This design of gantry crane was copied by many shipyards throughout the country.

Between the long mill building and the shipways, a distance of about 250 feet, is the woodworking machinery, which prepares the rough timber into a finished state for delivery to the ships. The timbers are handled by locomo-

tive cranes on tracks up to the head of the ways, where they are delivered to the gantry cranes running between each shipway. In the large mill building are located the joiner shop, the storeroom for the small ships' material and equipment, the small machine shop, coppersmith shop, pipe shop, blacksmith shop and tool room, as well as the miscellaneous shops, such as the saw hospital, electrical shop, belt shop and millwrights' benches. At the southwest end of the mill building is the main office.

Power Plant

The power plant consists of anthracite gas producers, which generate gas for operating two gas engines, each directly connected to a 175-kilowatt generator, and a 150-horsepower gas engine driving by a belt a 1,600-cubic foot cross compound Ingersoll-Rand compressor. Half of the plant machinery is driven by direct current generated at the plant, while the other half is driven by alternating current purchased from the East Penn Gas & Electric Company, of Bristol, Pa., stepped down from 13,000 to 2,400 volts at a transformer sub-station on the shipyard property and again stepped down to 440 volts by transformers located in the power house. This was done so that the possibility of the whole plant being shut down on account of lack of power would be eliminated.

The delay in securing ship material during the winter of 1917-18, due to the very severe winter and the congestion of the railroads, held the Traylor Shipbuilding Corporation back four months, and during that period there were only about 500 men employed at the plant; but after February, 1918, when ship lumber and material arrived in big quantities the payroll increased and reached its high peak in July, 1918, when there were about 3,500 men on the day shift and about 800 men on the night shift. During the summer months two shifts were operating continually.

Labor Conditions

On account of the fact that the wood shipbuilding industry had become practically "a lost art," it was impossible to secure experienced wood shipbuilders; consequently, the Traylor company resorted to the employment of ordinary house carpenters and laborers and instructed them in wood shipbuilding, so that it was not very long until the company had an efficient organization and working force. In October, 1918, when the Spanish influenza epidemic spread through the country, many of the men were sick, while others left for indoor employment, so that in November of that year only about 2,200 men were on the company's payroll. Shortly after the signing of the armistice the approach of winter and the continued published reports of the Shipping Board to the effect that the wood shipbuilding programme would be discontinued caused a further reduction in the working forces, so that in January, 1919, there were only 1,600 men on the payroll, just enough to carry the schedule of the delivery of ships through.

Effective Labor-Saving Devices

Many labor-saving devices were used in the Traylor yard—some designed and built by the Traylor organization and others purchased from machinery builders—so that whereas in the old days it took ten to fifteen months to build the hull of a wooden ship of about 3,500 tons capacity, it required an average of only five months for this work at the Traylor yard. The Traylor Shipbuilding Corporation has the distinction and honor of having turned out up to this writing (January 31) the largest number of completed ships of any of the shipyards on the Atlantic and Gulf coasts operating under United States Shipping Board contracts. A total of six ships was delivered up to January 31, 1919. As a comparison, the Hog Island yard, with fifty ways, to this writing has delivered only three ships; the Merchant yard, at Bristol, with twelve ways, one ship, and the Submarine Boat Corporation, at Newark, with twenty-eight ways, one ship.

The completed ships turned over to the Division of Operations of the Shipping Board in every instance made

Fig. 7.—Fastening Lower Shelf Timbers

highly satisfactory and successful dock trials at the shipyard at Cornwells and sea trials down the Delaware River past the Capes. In every case the ships were accepted by the United States Shipping Board, the American Bureau of Shipping and the United States Steamboat Inspection Service immediately after sea trial, without requiring any of the ships to go back to the yard for any repairs. This is a record of which the yard may well be proud.

The Crippled Soldier and Sailor, and How Their Disabilities May Be Discounted

BY DOUGLAS C. MC MURTRIE*

In the past, our method of dealing with men permanently disabled in the course of employment has been to pay the worker a pension in the form of compensation, and forget him and his injury. But the cost of disability in the shipping industry has not been alone in the premiums paid for casualty insurance. There has been the cost involved in the training, experience and adaptation of a skilled worker who does not return to his job, and the fitting of a newcomer to take his place.

There are three means of reducing and approaching the complete elimination of the cost of disability: first, accident prevention; second, thorough medical attention to minimize the disability resulting from the injury, and third, salvage of the remaining abilities of the worker through rehabilitation for self-support. The first of these has already received wide attention from employers and has wisely been encouraged in a financial way by casualty insurance companies and state funds. The values of the two latter have, however, not as yet been appreciated.

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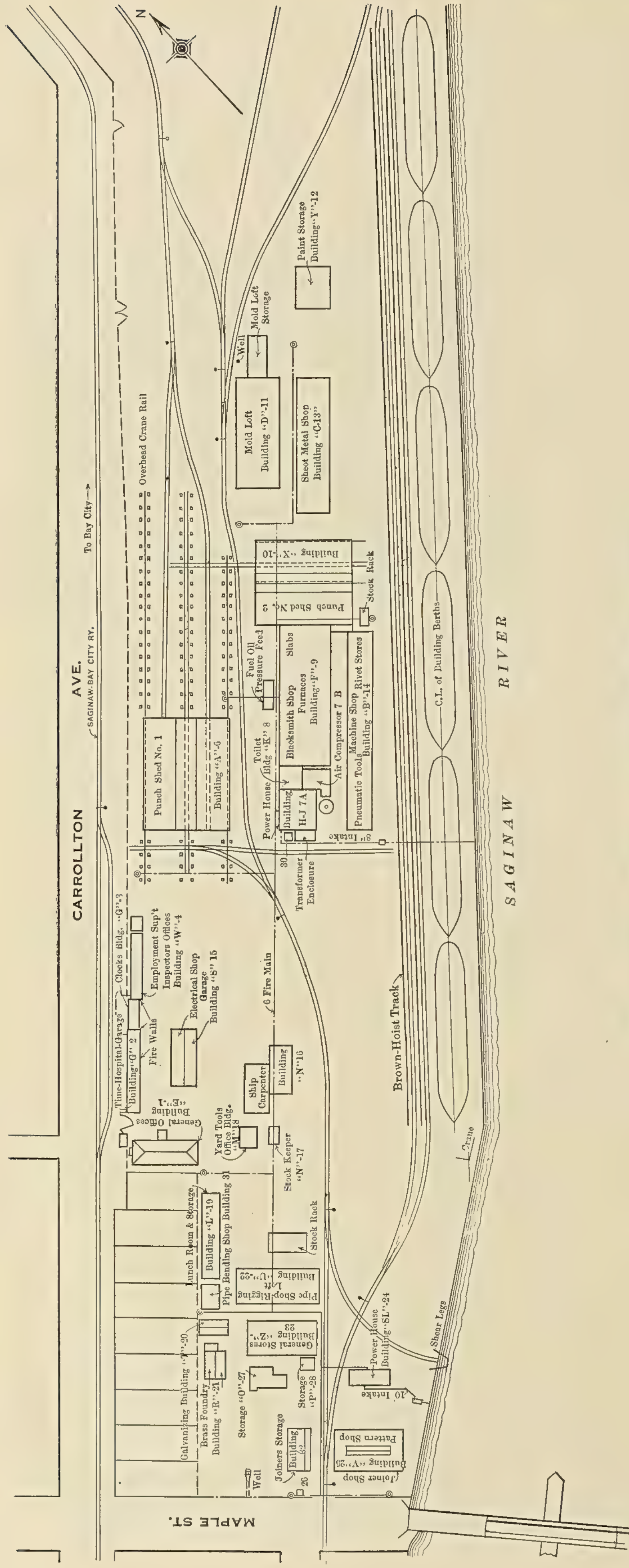


Fig. 1.—Layout of Shipyard of Saginaw Shipbuilding Company

Their enegetic application would effect a tremendous saving to industry.

Unlimited Medical Attention of the Highest Grade Should be an Axiom of Casualty Practice

Many injuries from which men would completely recover in a short time under adequate and high-grade medical attention are treated for an insufficient time, or by incompetent physicians and, instead of a prompt return to work, the case at best drags along over an extended period and at worst becomes chronic or develops into permanent disability. Some States require the insurance carrier to provide but two weeks of compulsory free medical attention to the injured man. For the insurance company to take advantage of this limitation is the most short-sighted policy possible, because for every dollar saved in physicians' or hospital fees, the insurance carrier pays out later ten dollars in compensation. And what the insurance company pays is actually paid by the insuring employers in their regular premiums.

Unlimited medical attention of the highest grade should be an axiom of casualty practice. It should be insisted upon by employer and workman alike. The best outcome of any injury is to have the employee return to his job as a well man in the shortest possible time. It is well to develop a science of dealing with cripples, but the ideal is to have fewer and fewer cripples with which to deal.

Rehabilitation for Self-Support

The third method of attack on the cost of disability is rehabilitation for self-support—the re-education of an injured man for an occupation which he can follow, or a process which he can perform, in spite of his handicap. The science of rehabilitation is new, and the experience in it has practically all been gained in the effort to make sound and just provision for the disabled soldier or sailor. Every country among the recent belligerents is to-day operating a comprehensive system of re-education for disabled soldiers, and is placing upon that system more dependence than upon the pension system.

Paying a man a small monthly or weekly stipend on which he is expected to live in idleness is not a very constructive method. With the breakdown of confidence in the pension system, it was realized that the only real compensation for disablement was restoration of capacity for self-support. It was further realized that very few jobs require all the physical faculties, and that in the present-day variety of industrial processes it is possible to find a job in which a man with a given type of disability can function 100 percent efficient.

Special School for Crippled Men

The process of retraining the disabled is known as re-education, and can best be

provided in a special school for crippled men. The first school of this kind in the United States is the Red Cross Institute for Crippled and Disabled Men, established in New York City through the generosity of Jeremiah Milbank. At this school, open to disabled civilians and soldiers alike, six trades are already being taught: artificial limb making, motion picture operating, oxy-acetylene welding, printing, jewelry work, and mechanical drafting. More will be added as the demand develops. Graduates are already giving satisfaction in the jobs to which they have been graduated, so the enterprise has passed the experimental stage. And in the results attained with disabled soldiers abroad, there is overwhelming evidence of the logic and practicability of rehabilitation.

The cost of soldier rehabilitation is being met by the United States Government and by the governments of some of our allies. It will be admitted without argument as desirable that the advantages of re-education be made available to disabled civilians as well, but will not the cost be prohibitive? The fact is that rehabilitation effects a reduction, rather than an increase, in the cost of disability, to industry or to the community as a whole.

In short, the first effort should be to prevent injury; the second, to minimize its permanent effects; the third—when disability has ensued—to offset its economic consequences. The execution of this complete program is not only sound humanitarian practice—it is good business as well.

Saginaw Shipbuilding Company

Construction of the new shipyard of the Saginaw Shipbuilding Company, Saginaw, Mich., was begun in the fall of 1917 and completed in the fall of 1918. Ship construction was begun in January, 1918, and was carried along simultaneously with the building of the plant.

Of the twenty-four ships under contract, twelve are of 3,500 deadweight tons and twelve are of 4,050 deadweight tons, all-steel cargo-carrying steamers of the ocean-going type. Six of these ships have been delivered to their owner, the United States Shipping Board Emergency Fleet Corporation. The second six are well along and rapidly nearing completion. A very large amount of material and equipment is on hand for the last twelve ships, and the work of fabricating this material and considerable construction work for these ships is well advanced.

The yard covers approximately forty acres of ground, with a shop floor space of over 160,000 square feet. There are six large building berths equipped to construct any size or type of ship that may be desired. In December, 1918, a total of 1,762 employees were at work in the yard. Owing to the close proximity of the plant to Saginaw and Bay City, Mich., the housing conditions for employees are excellent. Transportation is well taken care of, both by steam and electric lines.

The building berths extend along the waterfront for a distance of 1,700 feet, and there is still available on the present property holdings of the company a space of 700 feet for additional berths. Owing to the fact that one building berth is a continuation of another, a series of vessels of any desired length, whose total does not exceed 1,700 feet, can at the present time be constructed.

Two large fabricating shops, one of 19,900 and the other of 17,100 square feet area, have been erected. The plant is thoroughly equipped with all modern machinery and equipment necessary for the rapid construction of steel ships. Every convenience for the care, welfare and convenience of employees, such as a hospital with doctor and competent attendants, restaurant, toilets, wash-rooms, etc., has been installed.

The equipment for handling material consists of four 5-ton overhead electric traveling cranes, four 20-ton steam locomotive cranes, two 15-ton electric portal pier Brown hoists, and one switching locomotive.

Fig. 2.—Building Berths at the Saginaw Shipyard

Fig. 1.—General View of Fabricated Ship Corporation Yard

New Shipbuilding Enterprise in Milwaukee

Fabricated Ship Corporation Builds Yard for Construction of Steel and Concrete Vessels—Government Ships Under Construction

BY ARTHUR F. JOHNSON, M. E.*

THE Fabricated Ship Corporation, Milwaukee, Wis., was founded by the Newton and Coddington Engineering Companies, both of that city. The yard is equipped and laid out to build all types of steel or reinforced concrete vessels. It occupies about thirteen acres at the foot of Twelfth street and is waterbound on three sides. The property is long and narrow, facilitating a compact and efficient arrangement for sidewise launching.

Work on the yard was begun during the latter part of August, 1918. It was necessary to lower the grade three

* Production engineer and naval architect for the Fabricated Ship Corporation, Milwaukee, Wis.

Fig. 2.—Interior of Fabricating Shop

Fig. 3.—Mold Loft

Fig. 4.—Pattern Shop

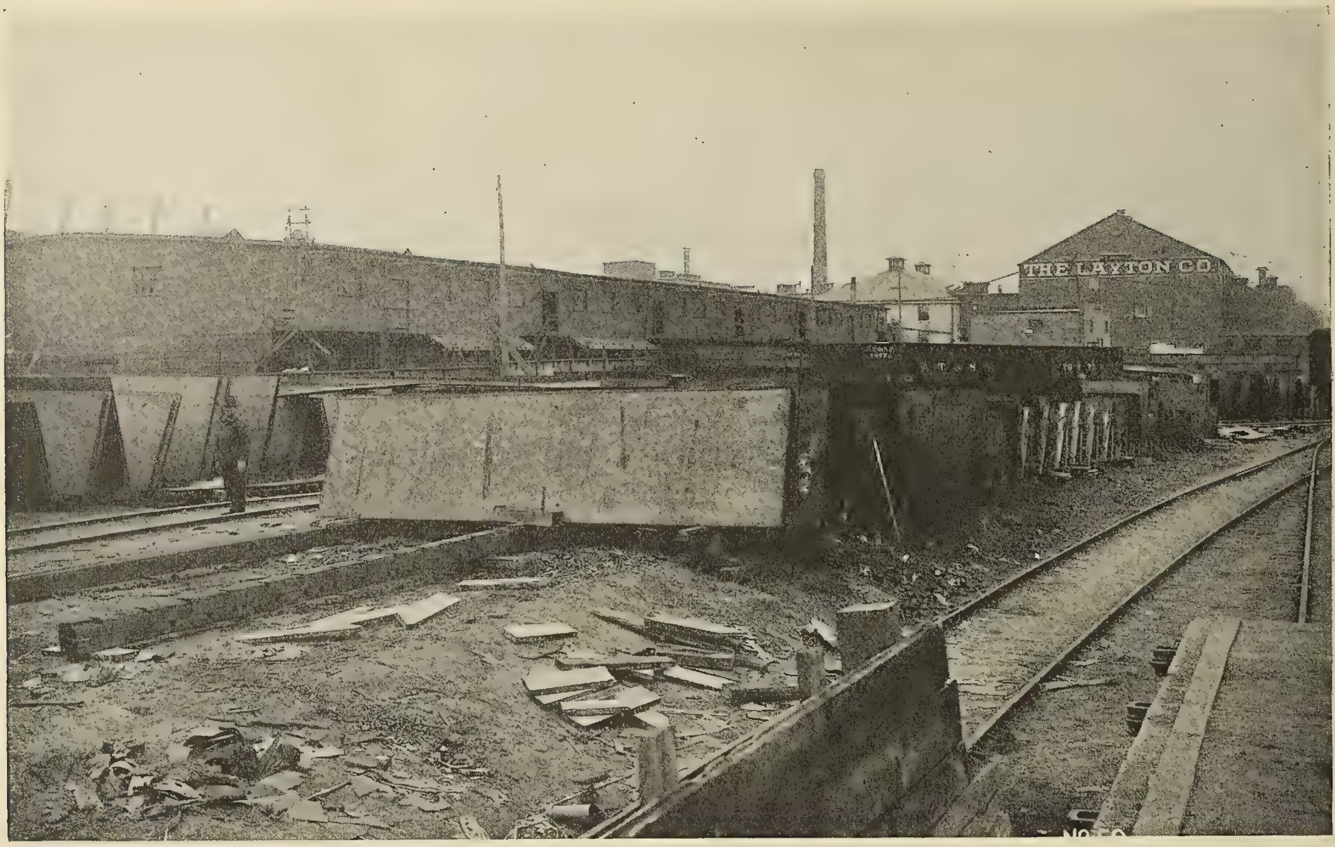


Fig. 5.—Plate Storage Yard

feet at the building berths, drive piles under the keels, repair and straighten the dock face, build new switches and railway tracks, erect buildings, install a power plant and yard machinery, build shipways, erect gantries and perform numerous other items incidental to the layout of a new yard.

Vessels Building for the War Department

The company is building nine twin-screw steel mine planters and four twin-screw steel river steamers for the Water Transport Branch, Embarkation Service, War Department. The design and early stages of construction for these ships were carried on simultaneously with the yard layout, as some of the pictures clearly show.

The administration building was on the property when taken over, so that with interior alterations it was soon ready for occupancy. The hull drawing office is located in the upper story of the administration building, and the engine drawing room is in a wing recently added. The mold loft was erected first and templates were shipped to the Lakeside Bridge & Steel Company, North Milwaukee, Wis. Here structural members were prepared for erection, a maximum amount of shop rivets being driven. Fabricated steel was erected in the yard before much of the final equipment was at hand, but the steel construction had just progressed to the desired stage when the plant was in condition to receive and handle what had been planned.

Arrangement of the Yard

The general arrangement, Fig. 1, indicates the possibilities for compact and efficient layout with sidewise launching. All material arrives at the land end and passes through successive stages in preparation to the finished product without doubling back in the processes. The raw material is stored at the entrance end, passing through the plate and angle shop to the storage for members ready for erection. From here it can be distributed to the building berths on each side of the "material zone." The warehouse, pipe shop, machine shop, power house and mold loft are at the far end of this zone.

Berths 1 to 7 are on the north side of the property on the Kneelands Canal. Berths 8 and 9, with the fitting-out dock, are on the south or Menomonee River side.

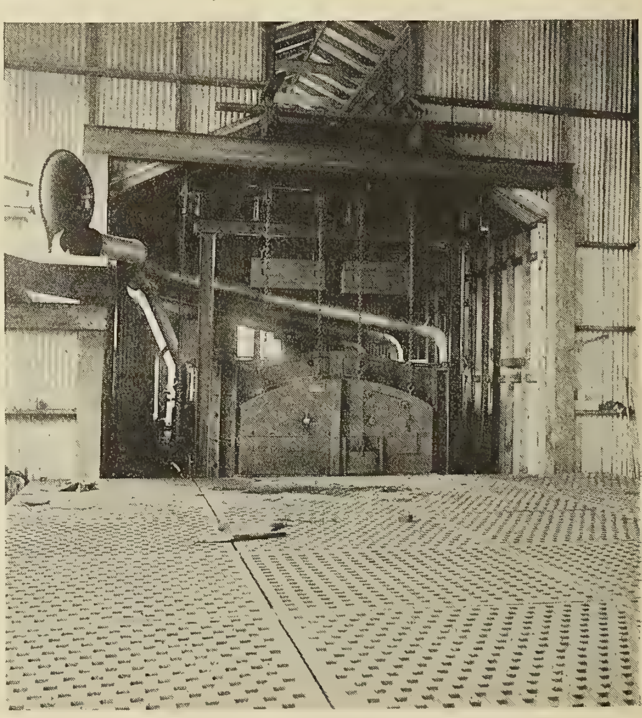


Fig. 6.—Heating Furnace and Bending Slab

Shops and Equipment

The plate and angle shop equipment consists of a large oil-burning furnace, bending slabs, blacksmith shop, plate shears, angle shears, planers, punches, etc. Material is handled by overhead trolleys, jib cranes, or by the standard gage railroad tracks through the center of the shop.

The hull superintendent's office is at the east end of the plate and angle shop, facilitating his constant observation of all steel production and erection.

Methods of Handling Materials

Hull material is handled by 15-ton electrically driven whirling gantries, one to each building berth. They outreach beyond the far side of the vessel and are raised on a triangular frame to a level well above the upper deck. On berths 1 to 5 the gantries are between the railroad tracks and building berths. The gantries at berths 6 and 7 are bridged over the main tracks. By this arrangement material can be unloaded from cars direct to the ships or to the space alongside of ships for temporary storage.

Fifteen-ton locomotive cranes handle material in the raw and finished storage spaces. They also serve for switching cars and handling miscellaneous material in the yard. Fixed derricks in the storage yards also handle material.

The machine shop, pipe shop, tool room, warehouse and offices of the machinery superintendent and master mechanics are on the lower floor of the large building between berths 6 and 7, and the power house at the eastern end of the property. The second story of this building is occupied by the mold loft.

Power Plant

The power plant furnishes electric and pneumatic power for all equipment and tools in the yard, as well as steam for heating and other purposes. Three large cylindrical return tubular boilers generate steam for the compressors and generators.

A 25-ton derrick is used at the fitting-out dock for installation of heavy weights, engines, boilers, etc.

Work is in view for commercial vessels of steel and reinforced concrete, and the yard has prospects of a lasting activity. Its location is favorable from the standpoints of labor and material markets, and Milwaukee is enthusiastically behind the project.

Repairs to Boilers by Welding.—The repairing of the boilers of passenger steamers by electric or oxy-acetylene welding has been tentatively in operation for a considerable period, and, in view of the experience gained, the surveyors of the British Board of Trade are directed that, provided the work is carried out to their satisfaction by experienced workmen, these processes may be employed within limits for repairing cracks in furnaces, combustion chambers and end plates of boilers and, in the same parts, for reinforcing the landing edges of leaky riveted seams which have become reduced by repeated chipping and calking. For the present it is not proposed to prohibit within limits the reinforcing of the circumferential seams of boiler shells, if the end plates are well stayed, but no welding should be done to these parts by any processes which might cause local heating over an appreciable area of the plate. In no circumstances should any part of a boiler of a passenger vessel be welded, if wholly in tension under working conditions, such as a stay or a shell plate at a longitudinal seam, the failure of which by cracking at the welded part might lead to disastrous results.

Wrecking Steamer Favorite Nearing Completion on the Great Lakes

The new wrecking steamer *Favorite*, building at the yard of the Great Lakes Towing Company, Cleveland, Ohio, to replace the wrecker of that name which was taken over by the United States Navy late in 1917, is about completed and will be ready for business at the opening of navigation on the Lakes. The *Favorite*, which is said to be one of the most complete salvage ships afloat, will be stationed at St. Ignace. Captain Alex Cunning, wrecking master for the Great Lakes Towing Company, will bring the new boat out, and James Callahan, who was chief engineer of the old *Favorite*, will have charge of her machinery.

The *Favorite* is 173 feet long, 40 feet beam and 16 feet molded depth. Her draft in ordinary trim is 7 feet 6 inches forward, 12 feet 6 inches aft, and with water ballast she can be trimmed to an even keel of 9 feet 6 inches. She is equipped with a 35-ton crane of the locomotive type without trucks, which is located above the pilot house. The crane is equipped with a 3-ton ore bucket. The vessel has a dynamo for furnishing lights for the crane and boom for night work.

The boat has a patent steam windlass and patent anchors of 4,000 pounds each, and 2,000 feet of 1¾-inch stud-link anchor chain, with two mooring engines with wire mooring lines located on the forecastle deck, and a steam capstan on the after deck, with towing machine with 1,200 feet of 2¼-inch wire towing cable, also located on the after deck. There is also a 5-ton crane of the stiff-leg type located on the after end of the house for serving the machine shop. The steering gear is of the Great Lakes Towing Company's design, with cylinders 6 inches and 16 inches diameter by 6 inches stroke.

Her propelling engine is of the fore and aft compound type, cylinders 25 inches and 50 inches diameter by 36 inches stroke, with independent condenser pump. Steam is furnished by three boilers. Each boiler has two Morison corrugated furnaces of 48-inch internal diameter, and 154 boiler tubes 3½ inches in diameter. Each boiler has a separate smokestack all contained in one casing, which is 8 feet in diameter.

A machine shop and blacksmith shop are located between decks in the stern, aft of the engine room, where the lighting plant is located. The lighting plant is divided into four separate units. A large two-stage air compressor and storage tank is provided for furnishing air for pneumatic tools, air hammers and pneumatic drills and divers. The vessel also carries oxy-acetylene tanks and burners and a portable arc electric welding machine.

The machine shop tools consist of a power bolt- and pipe-cutting machine, cutting up to 4-inch pipe or 2½-inch bolts; one engine lathe, 18-inch swing, 8-foot bed; power shaper of 24-inch stroke; drill press; emery wheel; power hack saw and power circular saw mill for sawing lumber.

Living quarters for the crew are all on the main deck, with running water in every room. The equipment includes an artificial ice machine and refrigerator, and water purifier with capacity enough to furnish all the water required by the crew for all purposes. The steamer is equipped with wireless telegraph and long-distance phone.

The wrecking outfit consists of a full equipment of steam pumps and their fittings, ranging in size from 4-inch suction to 16-inch diameter; thirty hydraulic jacks of 100 tons capacity each; two portable air compressors; ship chandlers stores; three sets of diving outfit, and submarine electric lights.

Fig. 1.—General View of the Principal Shops at the Federal Yard, Taken from Roof of Fabricating Shop. Joiner Shop and Machine Shop to the Left. Boiler Shop in Center. Forge Shop and Lumber Storage to the Right

Yard of the Federal Shipbuilding Company

Fully Equipped Steel Shipyard With Twelve Launching Ways Built at Kearny, N. J., by Subsidiary of United States Steel Corporation

ONE of the largest shipyards erected on the Atlantic coast during the war was that of the Federal Shipbuilding Company at Kearny, N. J., on the Hackensack River. The Federal Shipbuilding Company is a subsidiary of the United States Steel Corporation, and, with the co-operation of other subsidiaries of the parent organization, offers exceptional advantages for the production of vessel tonnage in quantity.

In order to meet immediate war needs, the Federal Shipbuilding Company has so far confined its efforts to the building of one type of ship, a single-screw cargo vessel of about 9,600 tons deadweight capacity, although the equipment of the yard and the size of the building ways are sufficient to accommodate vessels up to 15,000 tons deadweight.

Construction of the yard began in August, 1917. The first vessel was launched in June, 1918, and delivered early in October, 1918. Up to the present time, ten vessels have been delivered from the yard, and its present capacity, with a working force of about 8,000 employees, is sufficient for the production of twenty-four vessels annually.

The yard occupies a site comprising 170 acres, with a waterfrontage on the Hackensack River of 2,400 feet. Originally ten shipways were erected, but this number has been increased to twelve. All of the shipways are of timber construction carried on wooden piles. Tracks of the Newark branch of the Central Railroad of New Jersey extend along the southern and western boundaries of the yard, and tracks of the Pennsylvania Railroad enter the yard from the western side. In the northwest corner of the yard, adjacent to the main railroad tracks, is a classification yard for the storage, sorting and classification of fabricated material. As shown by the general plan of the

Fig. 2.—General View of Shipways from Fitting-Out Basin

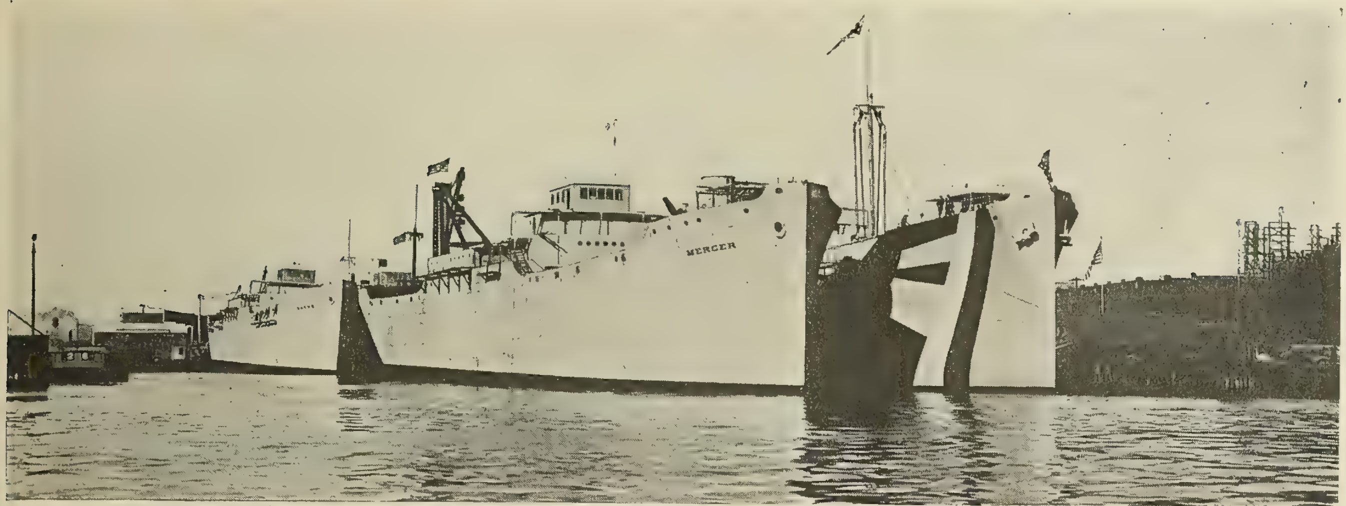


Fig. 3.—Steamships *Mercer* and *Federal*, with Other Vessels, Being Fitted Out in the Wet Basin

yard, standard gage railroad tracks extend to all the shops and down between the building ways. Material is handled throughout the yard by seventeen locomotive cranes, the largest of which have a maximum capacity of 35 tons. Raw material to be fabricated in the yard is stored in space immediately behind the plate shop, served by overhead traveling cranes.

At the shipways, material is handled by portable tower cranes operated by electricity on 40-foot gage tracks between the ways. The length of travel in each case is

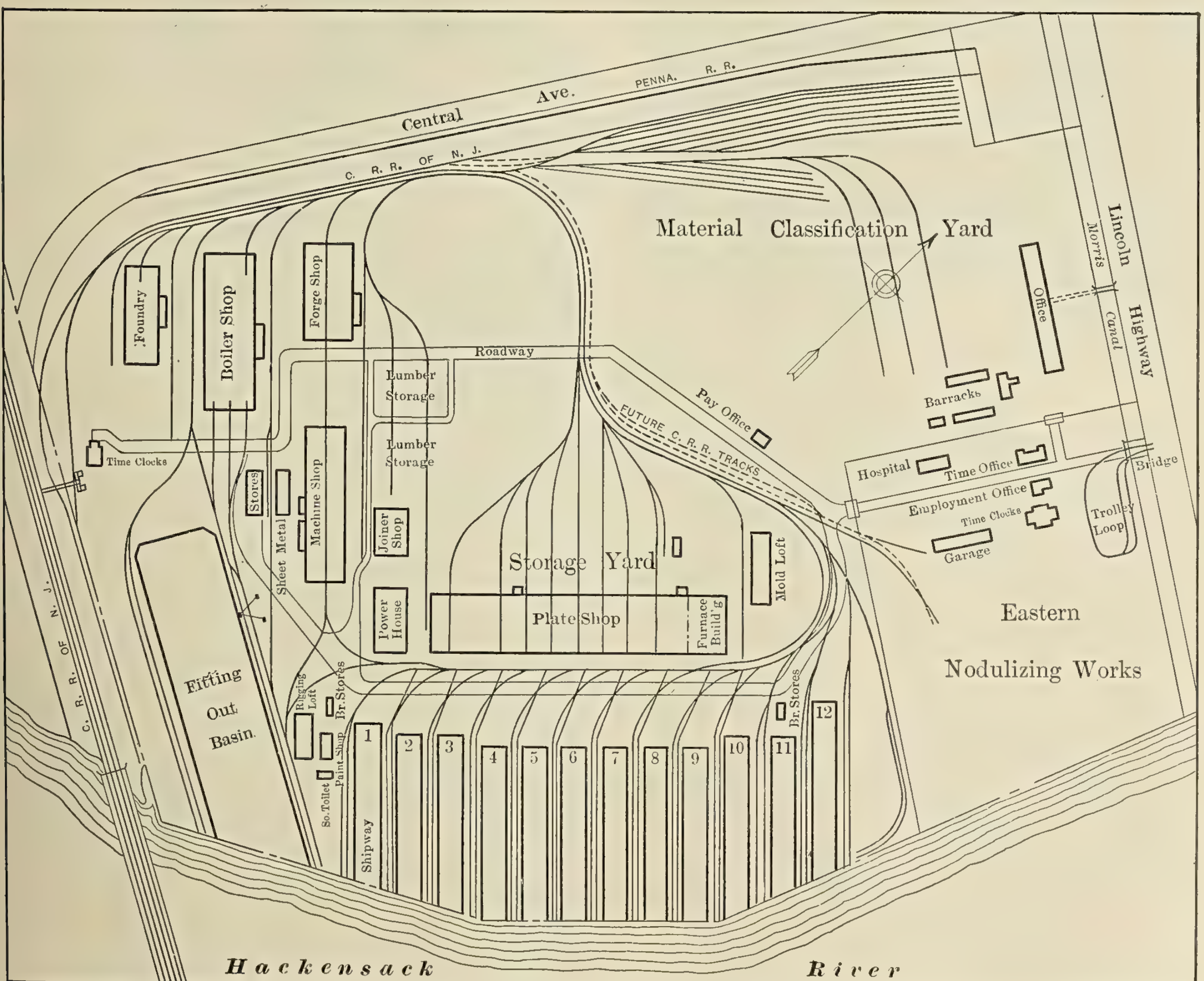


Fig. 4.—General Plan of the Federal Yard

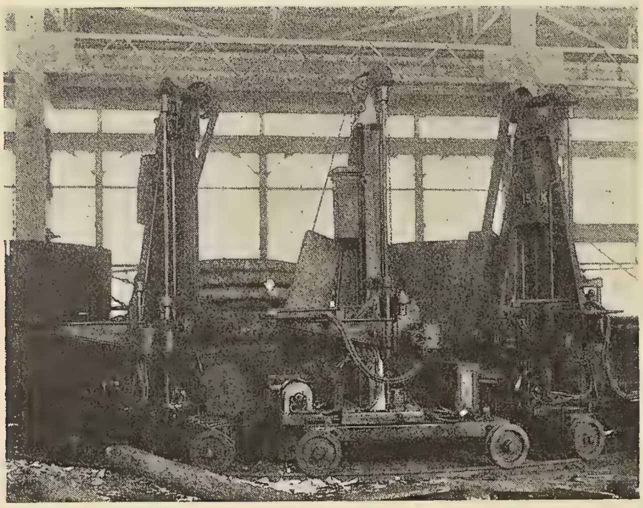


Fig. 5.—Three-Head Boiler Shell Drill in the Boiler Shop

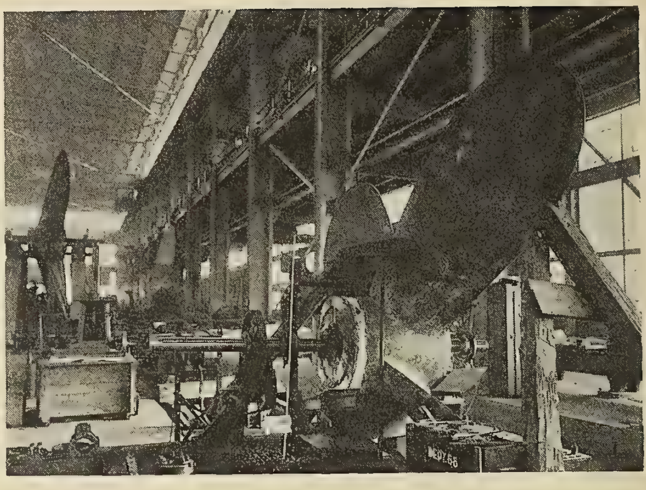


Fig. 7.—Boring Propellers in the Machine Shop

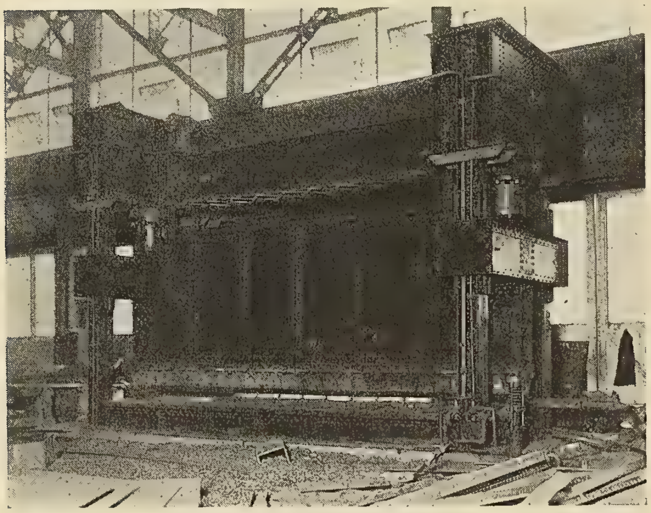


Fig. 6.—Keel-Bending Machine Built at the Yard for the Plate Shop

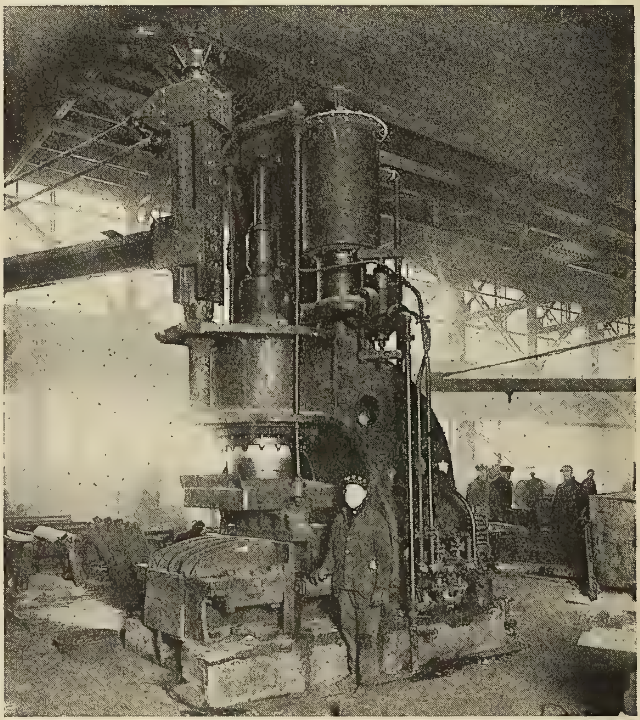


Fig. 8.—Frame Joggling Press in the Fabricating Shop

about 450 feet. There is one tower crane between each pair of ways. With the exception of two of these towers, which carry four derrick booms each, each of the portable towers carries two booms. All of the derrick booms have a capacity of 15 tons at a maximum reach of 65 feet. The lower ends of the derricks are 65 feet above the rails and the towers are built with open frame work, giving a clear height of 20 feet under the towers, so that freight cars and locomotive cranes can pass down the ways underneath the towers. Two standard gage railroad tracks extend down the length of the ways between the tower rails, so that material can be brought on cars to the exact location on the ways where it is to be erected. Space is also available between the ways for the temporary storing of a limited amount of fabricated material. The portable tower shipway cranes were designed and built by the Federal Shipbuilding Company in conjunction with the American Bridge Company.

At the head of the shipways and about 275 feet distant from them is the main plate shop, 800 feet long by 175 feet wide, which extends parallel with the waterfront. The wide space between the plate shop and shipways is used for the assembling of such parts of the vessels as bulkheads, transoms, deckhouses, tanks, skylights, etc. Ground assembly is further facilitated by an overhead crane runway with a span of 71 feet 3½ inches, carrying three electric traveling cranes, one of 35 tons capacity and the other two of 20 tons capacity each, immediately outside of the plate shop. Over the plate yard, immediately behind the plate shop, are two crane runways, on each of which are installed two overhead electric traveling cranes of 10 tons capacity each and two of 5 tons capacity each.

The plate shop itself is divided into three bays extending the full length of the building, each of which is served by three 10-ton overhead traveling cranes. The plate and angle furnaces are at the north end of the shop, and in an extension 120 feet long at this end of the building is the anglesmith shop. The plate shop is thoroughly equipped with the latest types of fabricating machinery. Material at the punches is handled on Lysholm punch tables, and all of the larger machines are equipped with individual electric or chain hoists operated on jib cranes. The arrangement of the machinery in the plate shop is such that the material passes in progressive steps from the plate yard in the rear of the shop to the assembly yard on the way side. Over the plate shop at the southern end are the

joiner and carpenter shops, while at the northern end is the mold loft.

Down the river, immediately below the shipways, is a wet basin used as a fitting-out berth, which has a capacity for fitting out eight vessels at one time. Near the fitting-out berth are a paint shop, ship riggers' shop, pipe shop and storehouses. A space at the end of the wet basin is reserved for the storage of pipe and fittings. Material is handled at the fitting-out berth by locomotive cranes, and for heavy weights such as boilers and engines a stationary three-leg jib crane of 100 tons capacity has been erected. This crane was designed and built by the Federal Shipbuilding Company in conjunction with the American Bridge Company.

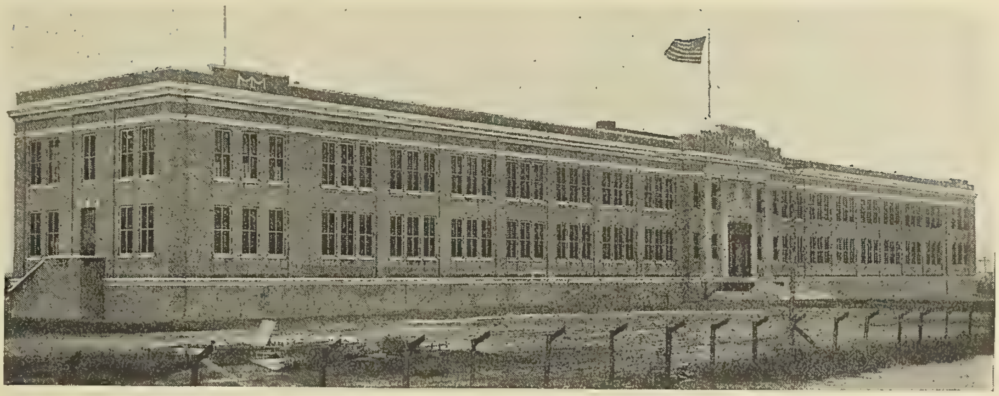


Fig. 10.—General Office Building

In addition to the plate shop, the yard is equipped with a machine shop, forge shop, boiler shop, foundry and carpenter shop. Each department is housed in a separate building, and all of the buildings are of steel, glass and tile construction.

Power is furnished from the Public Service station in the form of electricity at 13,000 volts, which is stepped down to 2,200 volts for operating the air compressors, 440 volts alternating current and 250 volts direct current for general machine use, and 110 volts single phase for lighting purposes. In the power house are five air compressors supplying a total of 22,000 cubic feet of free air per minute. Two of the compressors are Ingersoll-Rand machines, one with a capacity of 5,400 cubic feet and the other of 2,700 cubic feet of free air per minute. The other three compressors are of the Laidlaw-Dunn-Gordon cross compound type, each with a capacity of about 4,400 cubic feet of free air per minute. In the power house there is also a hydraulic plant with a capacity of 450 gallons per minute at 1,500 pounds per square inch pressure, consisting of three Dean hydraulic pumps and two accumulators supplied by the Camden Iron Works.

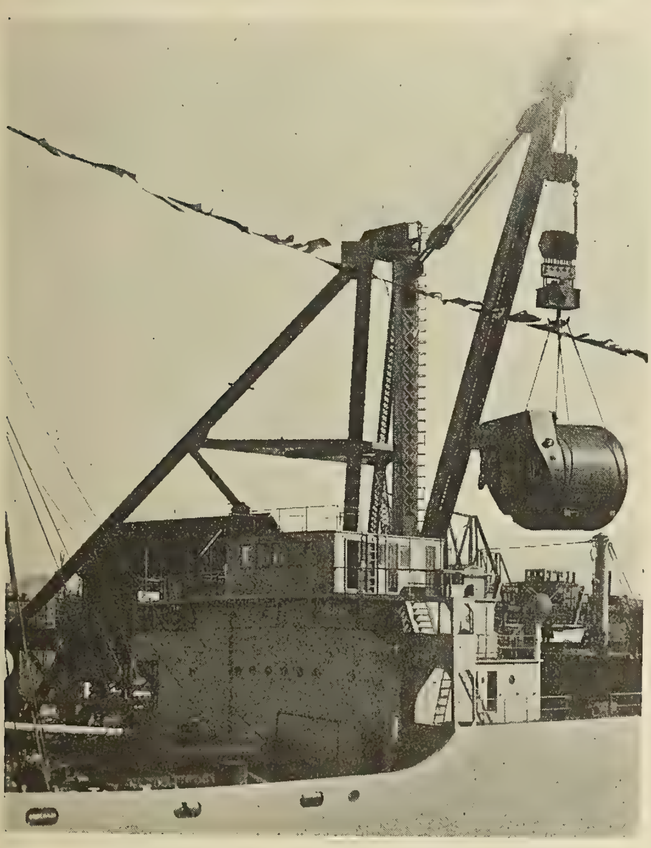


Fig. 9.—100-Ton Crane at the Fitting-Out Berth

Machine Shop

The machine shop is 500 feet long and 123 feet 8½ inches wide, with two side balconies each about 30 feet wide. In the central bay are two 50-ton Cleveland overhead electric traveling cranes, each of which has a 10-ton auxiliary hoist. The heavy planers and boring machines for machining stern frames, propellers and shafting are in the center bay, while the lathes and lighter machinery are in the north and south bays. As yet, the Federal Shipbuilding Company has not begun the manufacture of propelling machinery, although the machine shop is being equipped with suitable facilities for this work whenever it is found advisable to undertake engine building.

A special feature of this yard is the splendidly equipped shop for building Scotch boilers. The shop itself is 500 feet long and 161 feet 6 inches wide, to which an extension 85 feet long is being added. The shop has a capacity for turning out annually 175 three-furnace, single-end Scotch boilers each 15 feet 6 inches diameter by 11 feet long with a heating surface of from 3,500 to 3,600 square feet.

Equipment of Boiler Shop

The shop is divided into three bays. The center bay is served by three overhead electric traveling cranes of 50 tons capacity each; the eastern end of the bay is utilized as an erecting floor, and the western end for the bending, drilling and riveting of the heavy shell plates. The equipment here includes a set of Southwark vertical bending rolls; one 200-ton bull riveter; one 150-ton bull riveter; two 75-ton bull riveters and two 90-ton portable riveters; one three-head Bethlehem shell drill, and one three-head shell drill built at the yard. In the south bay are the machines for punching, shearing, planing and drilling the plates. The equipment includes sixteen radial drills, several long-arm radial drilling and countersinking machines, three plate planers, bending rolls, etc. Jib cranes with chain hoists are provided for handling material at the larger machines, and this bay is also equipped with two 20-ton overhead electric traveling cranes with 5-ton auxiliary hoists. At the west end of the bay are the furnaces and bending slabs and sectional flanging machines. The northern bay, served by two overhead traveling cranes, is

used principally for the lighter sheet metal work, such as casings, uptakes, tanks, etc.

The forge shop is 300 feet long by 151 feet wide. Part of this building is used as a drop forge shop and is equipped with six Erie steam hammers ranging from 400 pounds to 2,000 pounds, two Ajax riveting machines and a die sinking department. The rest of the building is taken up with solid smith work, for which six Erie single-frame steam hammers, ranging from 800 to 1,500 pounds, are provided. There is also a United Engineering 350-ton hydraulic press. The center bay of this shop is served by a 15-ton overhead electric traveling crane supplied by the Erie Steel Construction Company.

In addition to the above, there is a foundry 300 feet long by 103 feet wide equipped with two iron cupolas, each with a capacity of 12 tons. The foundry is also provided with equipment for furnishing brass castings up to one ton. The center bay of the foundry is equipped with two 20-ton Milwaukee overhead traveling cranes.

The main offices of the company are located in a two-story general office building 420 feet long by 55 feet wide, near the main entrance. The administration offices are on the first floor of the building and the engineering department on the second floor. At the main entrance are the time clocks and employment offices, and nearby is a well-equipped emergency hospital.

American Shipbuilding Company Launches 108 Vessels Aggregating 389,000 Tons Deadweight in Sixteen Months

FIFTY-FOUR percent of the total tonnage turned out on the Great Lakes for the emergency fleet was produced from the yards of the American Shipbuilding Company, Cleveland, Ohio. During the sixteen months beginning August, 1917, and ending November, 1918, this company launched 103 ships aggregating 362,000 tons deadweight for the Emergency Fleet Corporation, and, in addition, three bulk carriers aggregating 27,000 tons deadweight for Great Lakes service and two special steamers for the United States Navy, or more than the total output of American shipyards during any one year prior to 1917.

When navigation opened in the spring of 1918 a completed fleet of 16 vessels, which had accumulated at the various plants of the American Shipbuilding Company during the winter of 1917-18, sailed for the seaboard, followed at intervals by 71 more vessels before the close of navigation in 1918. These vessels are of the standard Great Lakes single-deck type of ocean carrier, 261 feet long overall, 251 feet between perpendiculars, 43 feet 6 inches beam and 21 feet 2 inches depth of hold, fitted with reciprocating engines of 1,200 indicated horsepower, designed to give the ships a speed of 9½ knots. Sixty more vessels of the same type, but of larger size, will be delivered in 1919.

The American Shipbuilding Company controls eight separate plants, seven of which are in the United States and one in Canada. Six of these plants are equipped for building ships, and during the past year the output was at the rate of twelve ships a month from all the yards.

This immense output from the yards of the American Shipbuilding Company was not accomplished without a considerable increase in the facilities at the various yards. Both the boiler and machine shops operated by the company in Detroit, Mich., were doubled in capacity, and the additional shipways provided are shown in the following table:

Location of Yard	Original Number of Shipways	Present Number of Shipways
Wyandotte	4	10
Lorain	8	8
Cleveland	2	3
Buffalo	1	3
Chicago	2	5
Superior	3	5
Total	20	34

During the war, night shifts were employed in the plate shops, but not on the hulls. In all, about 12,500 employees were engaged in this work. The plants controlled by the American Shipbuilding Company are the following: American Shipbuilding Company (Globe plant), Cleveland, Ohio; American Shipbuilding Company, Lorain, Ohio; Detroit Shipbuilding Company, Detroit, Mich.; Buffalo Dry Dock Company, Buffalo, N. Y.; Chicago Shipbuilding Company, South Chicago, Ill.; Western Dry Dock & Shipbuilding Company, Ltd., Port Arthur, Ontario, Canada; The Superior Shipbuilding Company, Superior, Wis., and Milwaukee Dry Dock Company, Milwaukee, Wis.

National Merchant Marine Association Organized to Aid the Development of the American Merchant Marine

AT a preliminary conference of men interested in shipping, shipbuilding and maritime affairs, held in Washington on January 22 and 23 under the leadership of Senator Joseph E. Ransdell, of Louisiana, it was decided to organize a national association, to be known as the National Merchant Marine Association, for the purpose of aiding and developing a plan and programme under which an American merchant marine can be practically and successfully established. At this meeting a council was appointed to act as the governing body of the association. At a subsequent meeting of the newly-appointed council on March 17, Senator Joseph E. Ransdell was elected president of the association. Further steps in the organization of the asociotion resulted in the election of an executive committee and four vice-presidents. The results of the election, as well as the names of the members of the council, are published elsewhere in this issue.

It is the purpose of the newly organized National Merchant Marine Association to aid in the development of a merchant marine under the American flag adequate to the needs of the American commerce and to provide the merchant ships adequate to meet the military and naval requirements of the country in time of war. The association is composed of some of the best-informed and most influential men in the marine industries, and it is to be their main business as an organization to develop all facts relating to the need of the United States for having a merchant marine under its own flag and to develop and suggest to Congress a shipping policy and laws which will promote the best interests of the country as a whole. The immediate necessity, of course, is to develop and advance practical suggestions for the disposal of the tonnage already built or contracted for by the Shipping Board.

The best American talent from all the co-ordinate branches of the marine industries must be depended upon for advice and guidance in developing the new merchant marine under existing conditions, and it is believed that the National Merchant Marine Association, through its organization and resources, will be in a position to render valuable aid in solving this national question.

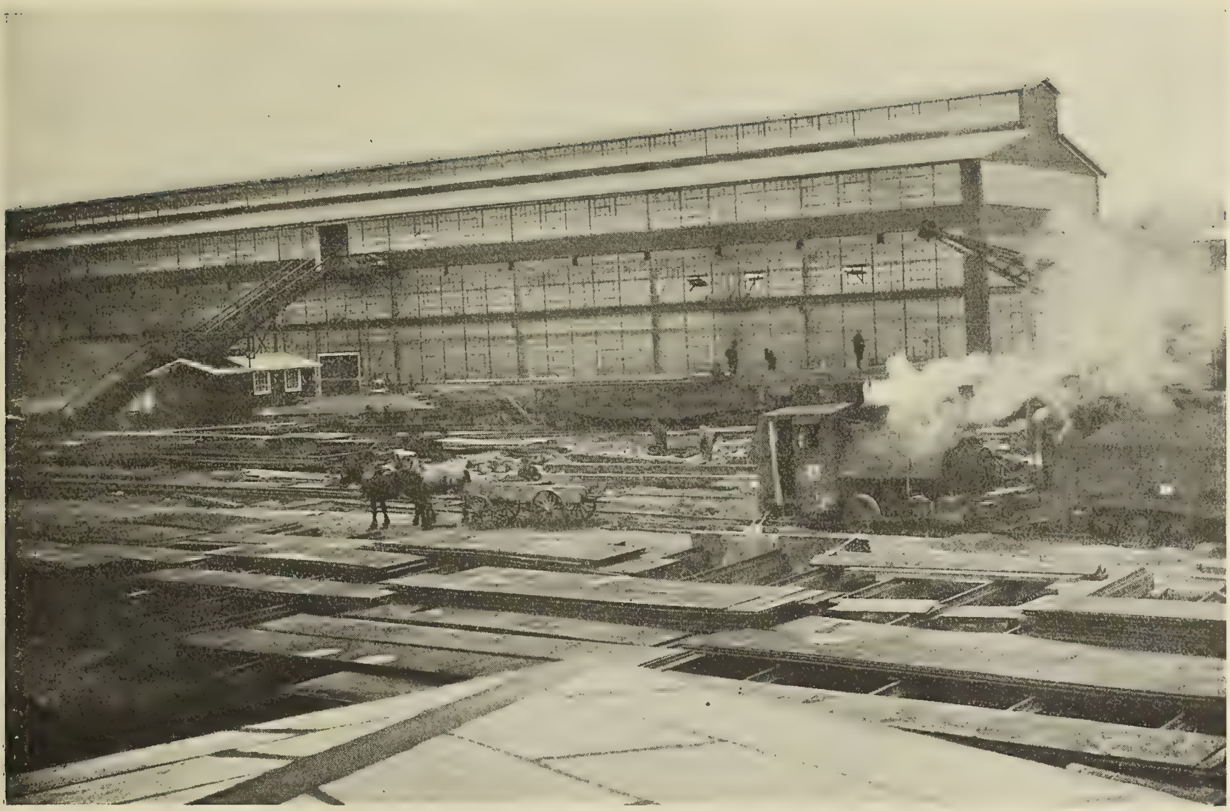


Fig. 1.—Assembling Shop and Mold Loft. Section of Plate Storage Yard in Foreground

Manitowoc Shipbuilding Company

Steel Shipyard on the Great Lakes Quadrupled in Capacity to Meet Demands for Sea-Going Tonnage

DURING the past two years the Manitowoc Shipbuilding Company, Manitowoc, Wis., has practically quadrupled its capacity for building ships. Before the war it had three building ways and could turn out six ships in a year. It now has six building ways and can turn out twenty-four ships annually. Formerly its working force numbered about 750, but at present 2,200 employees are on the payroll. In 1917 four steamships and several steam trawlers were built at the yard; in 1918 the output consisted of twelve standard Emergency Fleet vessels; in 1919 the company's schedule calls for the delivery of twenty-four ships.

Development of the Plant

The phenomenal growth of this shipyard represents what in ordinary times might be accomplished in perhaps ten to fifteen years of steady development. Needless to say, advantage has been taken of the opportunity to build up the company's resources in equipment and organization so that the plant embodies the latest ideas and facilities for ship production. The Manitowoc yard is fully equipped for building not only hulls and propelling machinery, but many of the deck and engine room auxiliaries, including winches, windlasses, steering gear, pumps, condensers and the like, as well as much of the equipment of a steamship, including lifeboats. In this respect the Manitowoc yard is a notable exception to the average shipbuilding establishment on the Great Lakes. About the only equipment which comes from outside the yard is the electrical apparatus, independent pumps, refrigerating machinery, navigating instruments, etc.

The Manitowoc yard is situated on a peninsula 2,000 feet long by 800 feet wide covering 35 acres on the Manitowoc River about a mile from Lake Michigan. The yard has a waterfront of one mile, with a depth of water around the peninsula of about 21 feet. Two railroads, the Chicago & Northwestern and the Soo Line, connect with the yard. Three sources of power are available, the Wisconsin Public Service (High Falls), the Reiss Coal Company, which is located across the river from the shipyard, and a power plant in the shipyard. The Public Service current is received at 4,000 volts and stepped down in transformers to 440 volts for the compressor motors and certain alternating current motors in the yard. Part of the alternating current is converted in General Electric synchronous rotary converters to 250 volts direct current, which is used for variable speed cranes and other direct-current equipment. Power from the Reiss plant is received at 250 volts direct current and used for the balance of the power and lighting requirements. The yard plant has three 40-kilowatt generators, which are used principally for operating the pumps of the dry docks.

Power Plant

The average power requirements at the yard are from 1,500 to 2,000 horsepower. The air compressor equipment includes three Ingersoll-Rand machines, one with a capacity of 2,400 cubic feet, one of 1,200 cubic feet, and the

Fig. 2.—Eastern End of Manitowoc Yard, Showing Shipways and Floating Drydock

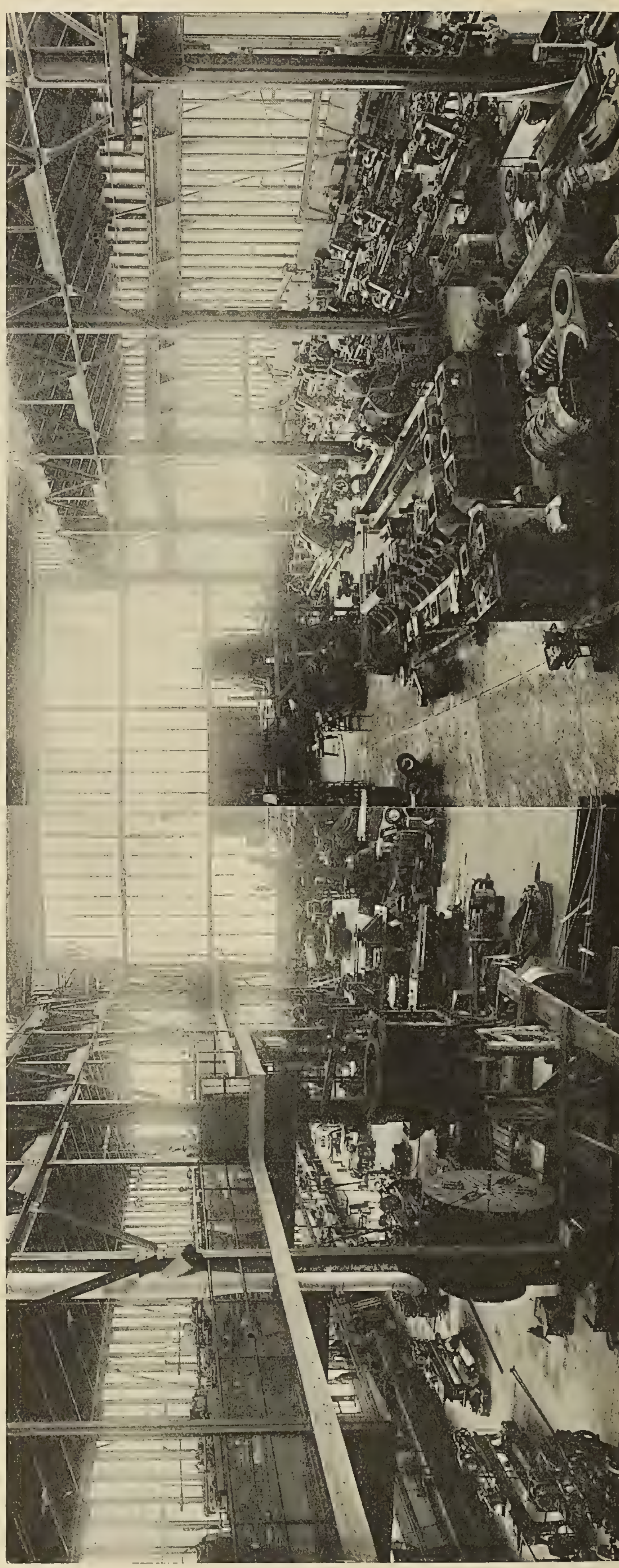


Fig. 3.—Machine Shop. Building is of Steel Frame Construction With Glass Sides. Gallery at Left for Light Machine Work

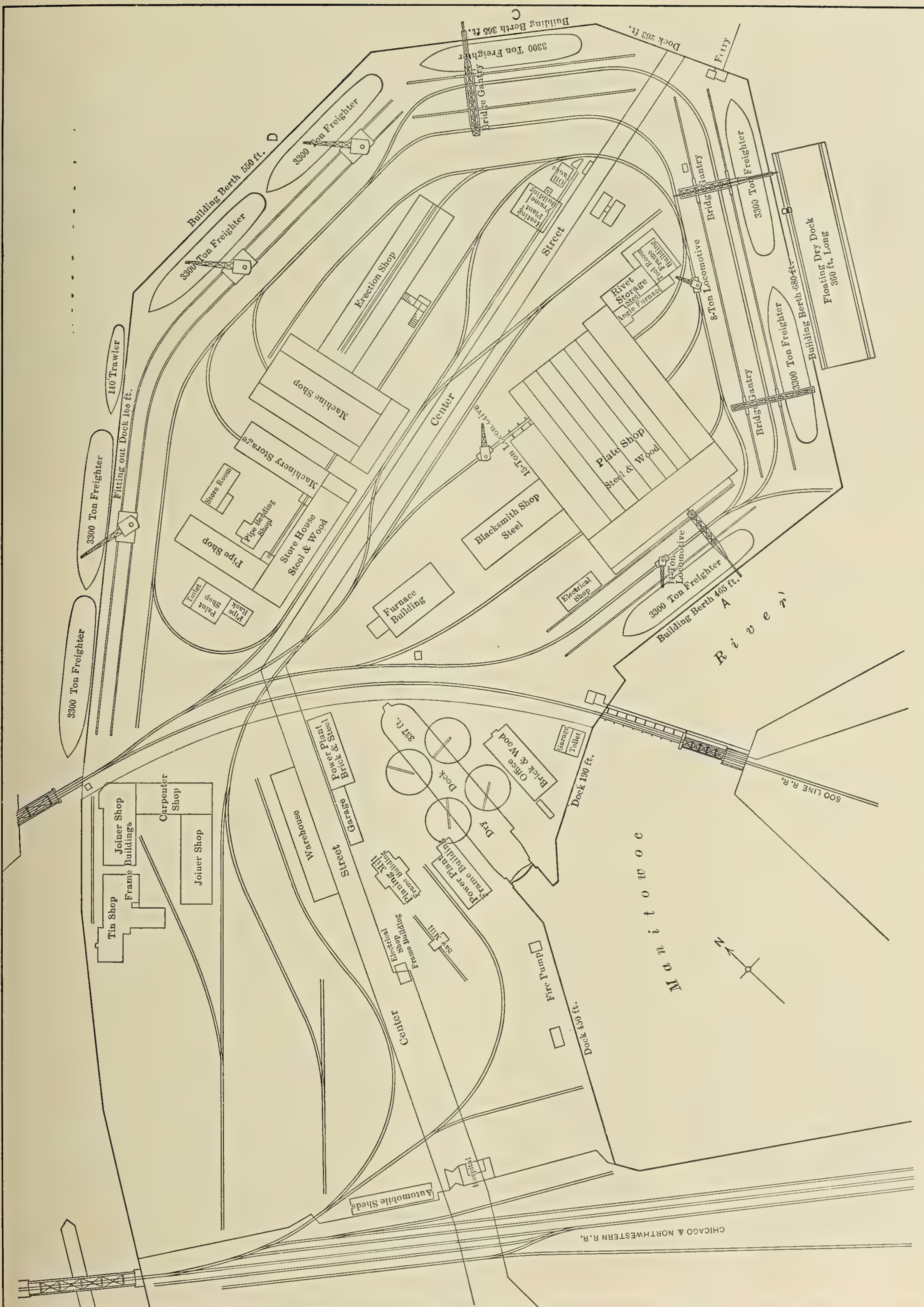


Fig. 4.—General Plan of Manitowoc Shipyard

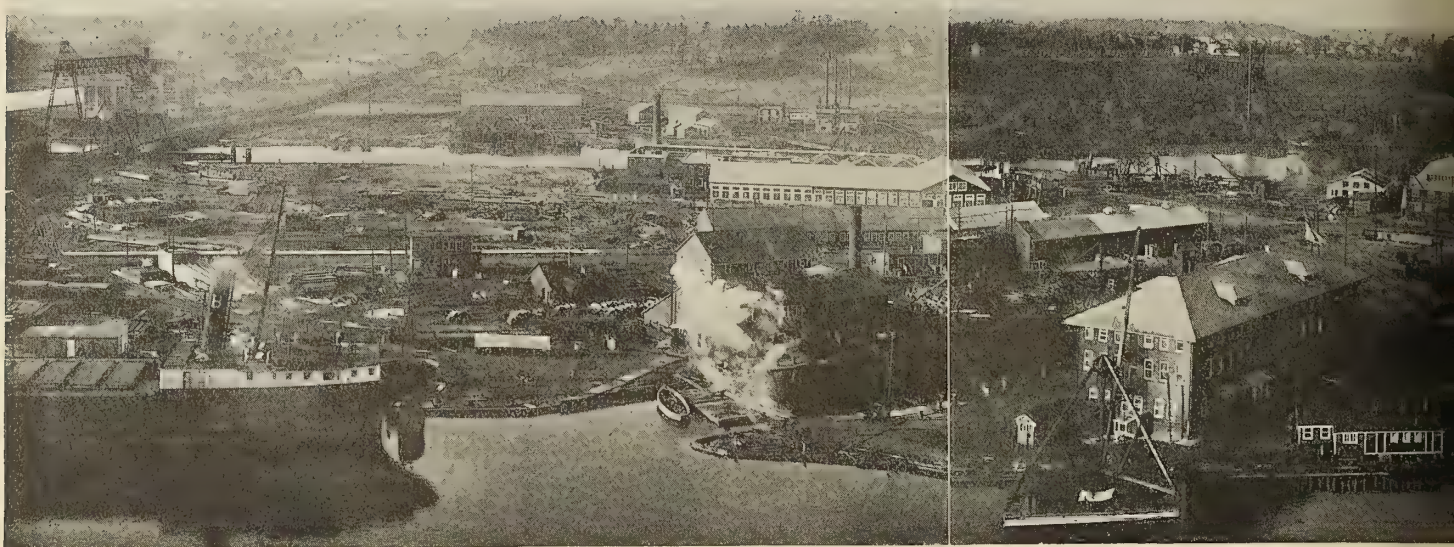


Fig. 5.—Panoramic V

third of 600 cubic feet of free air per minute, and two Chicago pneumatic tool compressors of 1,100 cubic feet capacity each. There is also a compressor of 300 cubic feet capacity in the machine shop, which is used to take care of night work.

The compact arrangement of the yard is shown in the general plan, Fig. 4. The six building berths, placed end to end around the circular end of the peninsula, are of timber construction. The keel blocks rest on timbers, which in turn rest on two rows of wooden piles. Footings for the bilge shores also rest on wooden piles. Along the outer edge of the ways is a bulkhead built of wood piles and triple-sheet piling anchored back to wooden piles. On account of the circular shape of the peninsula, the various shops are most advantageously located with respect to the departments which they are to serve. A roadway, or street, extends down through the center of the yard, and spur tracks from both railways lead to the storage yards and shops.

Fig. 6.—Floating Dry Dock

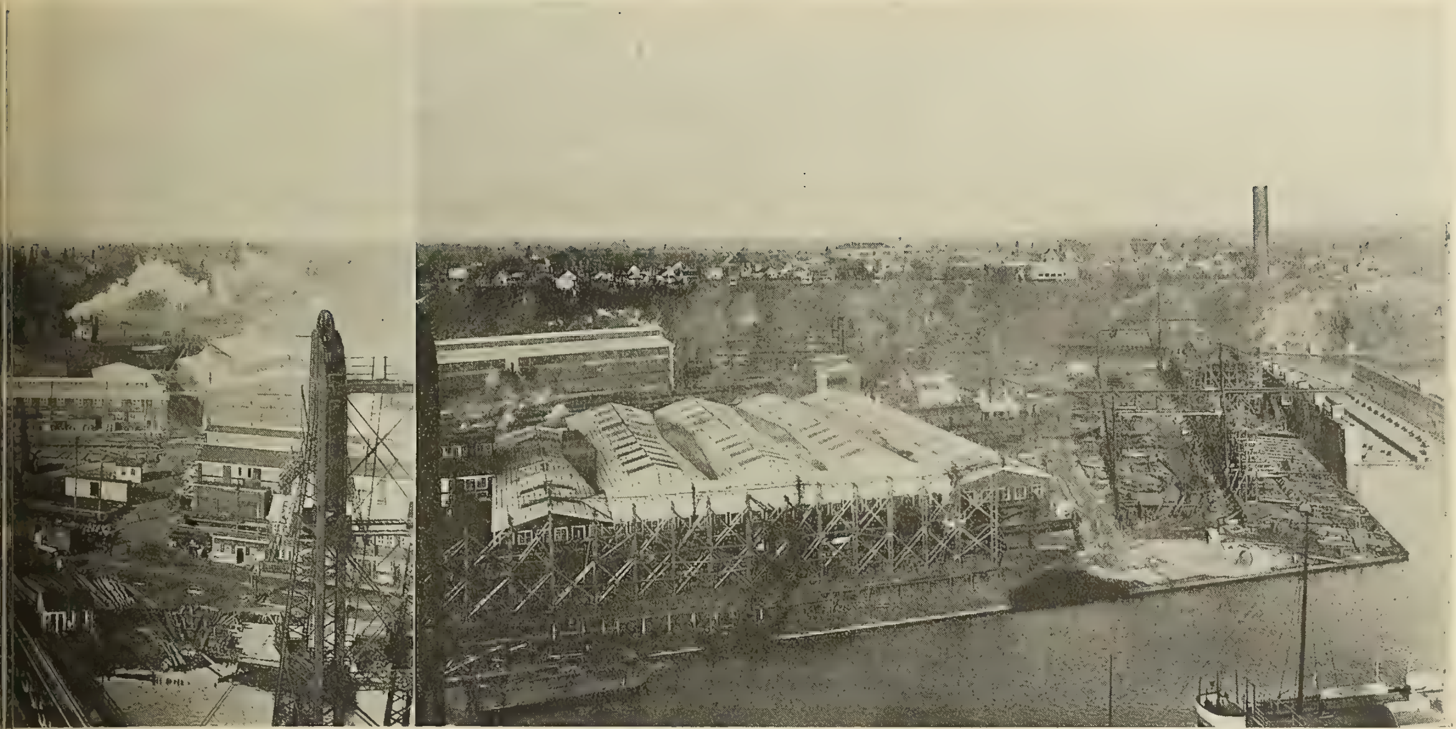
Method of Storing Material

An outstanding feature of the yard is the arrangement for storing material. Storage space for fabricated material in connection with large storage space for raw material gives a production "cushion" on both sides of the fabricating operation. Fabricated material properly classified is piled beside each ship on the ways. Most of the carload material enters the yard on the Soo Line spur. Ample space is provided so that material can be stored in piles lying flat on skids, the plates being arranged by strake letters and frame numbers so that a ship fitter can lay out the top plates on each pile rapidly, and as fast as they are taken away by a locomotive crane the operation can be repeated for another ship. The large storage space, provided with ladder arrangement of spur tracks, giving quick access to material in any part of the yard, has proved a vital factor in the efficient operation of the plant. Altogether there are over three miles of railroad tracks in the plant.

The material is carried to the shops and ways by locomotive cranes. The company has an 11-ton switching locomotive, two Link Belt 15-ton 40-foot boom and one Browning 18-ton 50-foot boom locomotive cranes for this purpose. They also have two Davenport gasoline (petrol) cranes, one of 15 tons capacity with a 40-foot boom, and the other of 10 tons capacity with a 30-foot boom.

Shipway Cranes

At the building berths material is handled by gantry cranes. At all of the berths but one the gantries are of a bridge type of four tons capacity, designed by the Manitowoc Shipbuilding Company. They are 47 feet high, mounted on an elevated 70-foot gage track, and extend over the building berths as well as a short distance over the storage space on the inland side of the gantry tracks. Each crane has two hoisting drums. The controller hoist runs back and forth with the load, and, as it is provided with glass sides and bottom, the operator always has an unobstructed view of the movements of the load.



Manitowoc Shipyard

Two other gantries, which serve the two northern building berths are McMyler tower erecting cranes with 98-foot booms. These cranes have a capacity of 6 tons each at a 53-foot radius and travel on a 24-foot 2½-inch-gage track. In addition to the above equipment, the company has added another 15-ton McMyler gantry for the heavy lifts and a light locomotive crane with a 70-foot boom for the fitting-out berths.

The outfitting dock is about 800 feet long, with a capacity for three standard ships. An additional outfitting berth of about the same capacity has been added, which will be a continuation of the present berth and double the capacity.

Plate Shop

The shops at the plant include a plate and shape shop, blacksmith's shop, boiler shop (situated a mile down the river from the plant), machine shop, forge shop, pipe and plumbing shop, tin shop, electrical shop, carpenter and joiner shop, and paint shop. There is also an assembly shop with mold loft above and a plate furnace shop.

The plate shop is 350 feet long by 260 feet wide, divided into eight bays. The outside bays are served by 2-ton mono-rail hoists, and the center bays by hand-control chain hoists. One-half of the shop is used for laying out and furnacing the plates and one-half for punching, shearing and bending. At the punches the plates are handled on roller skids of a special type built at the yard, while at the shears the plates are handled by chain hoists having straight-line motion parallel with the shears. The plate shop contains light and heavy bending rolls, a joggle press for frames and an hydraulic cold flanging machine.

In general, all plates enter the punch shop transversely at the northern end and travel south through the shop. Channels for frames enter at the northern corner, where they are bent and then moved westward and pass through the west side of the shop. Angles enter the shop at the southern end and are worked transversely through the shop.

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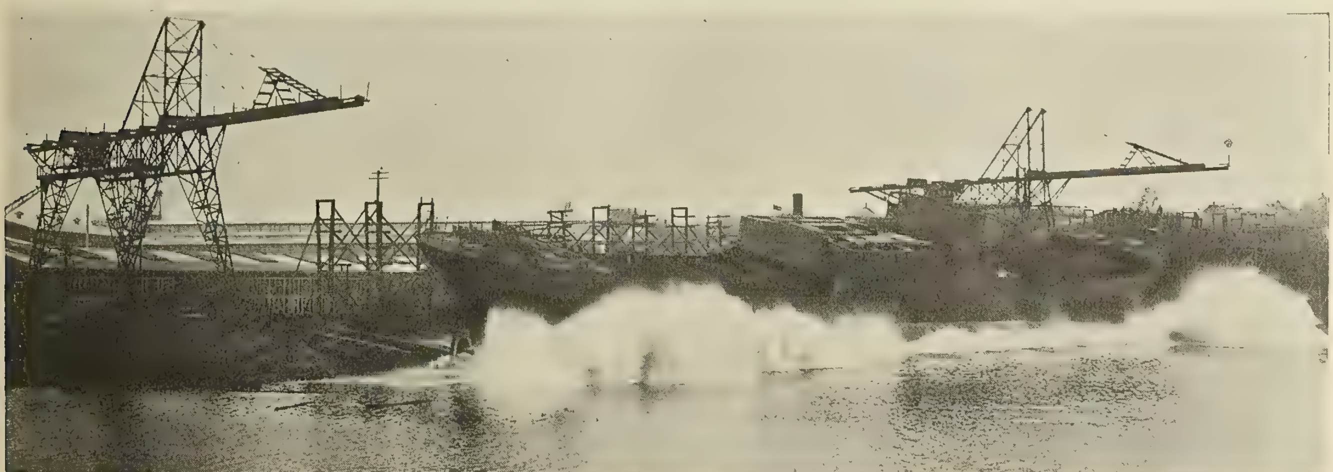

Fig. 7.—Launching of Vessel at One of the Shipways

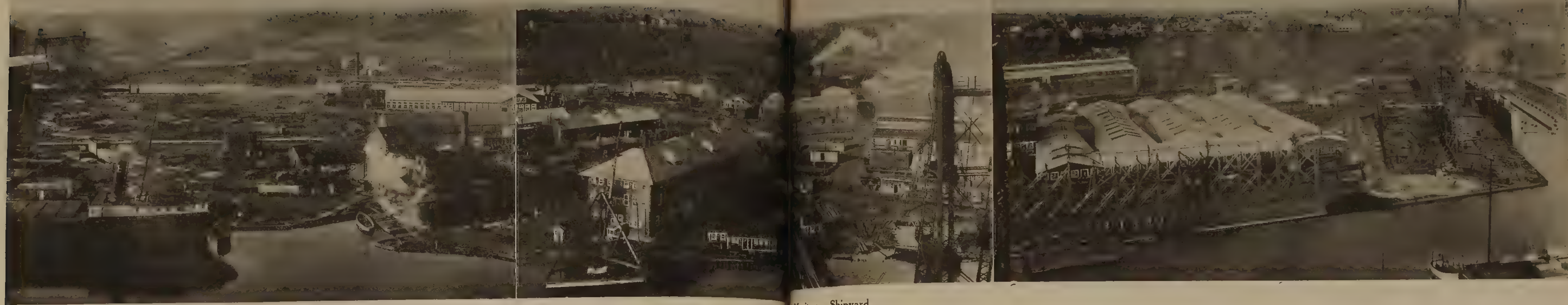

Fig. 5.—Panoramic View of Manitowoc Shipyard

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Fig. 7.—Launching of Vessel at One of the Shipways

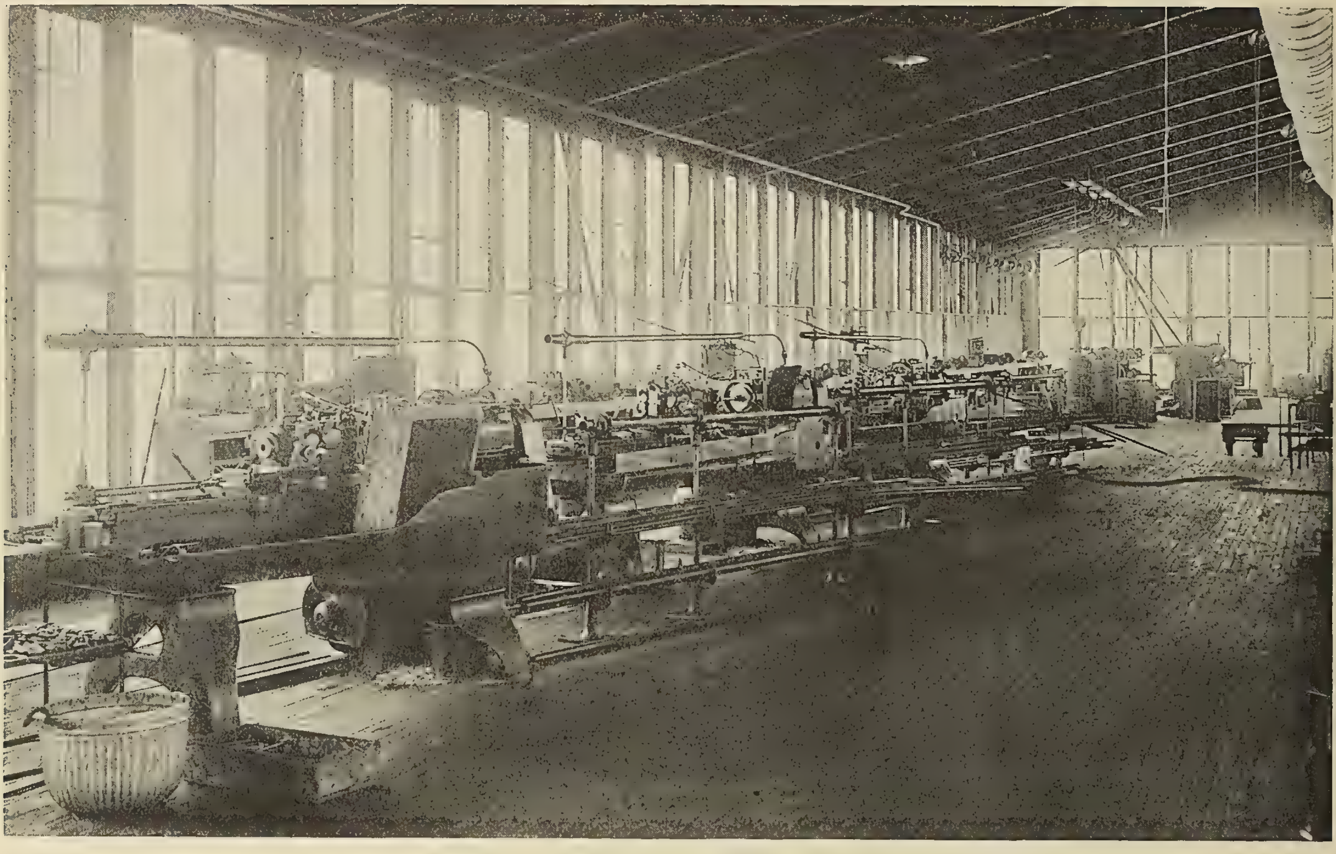


Fig. 8.—Gallery in the Machine Shop

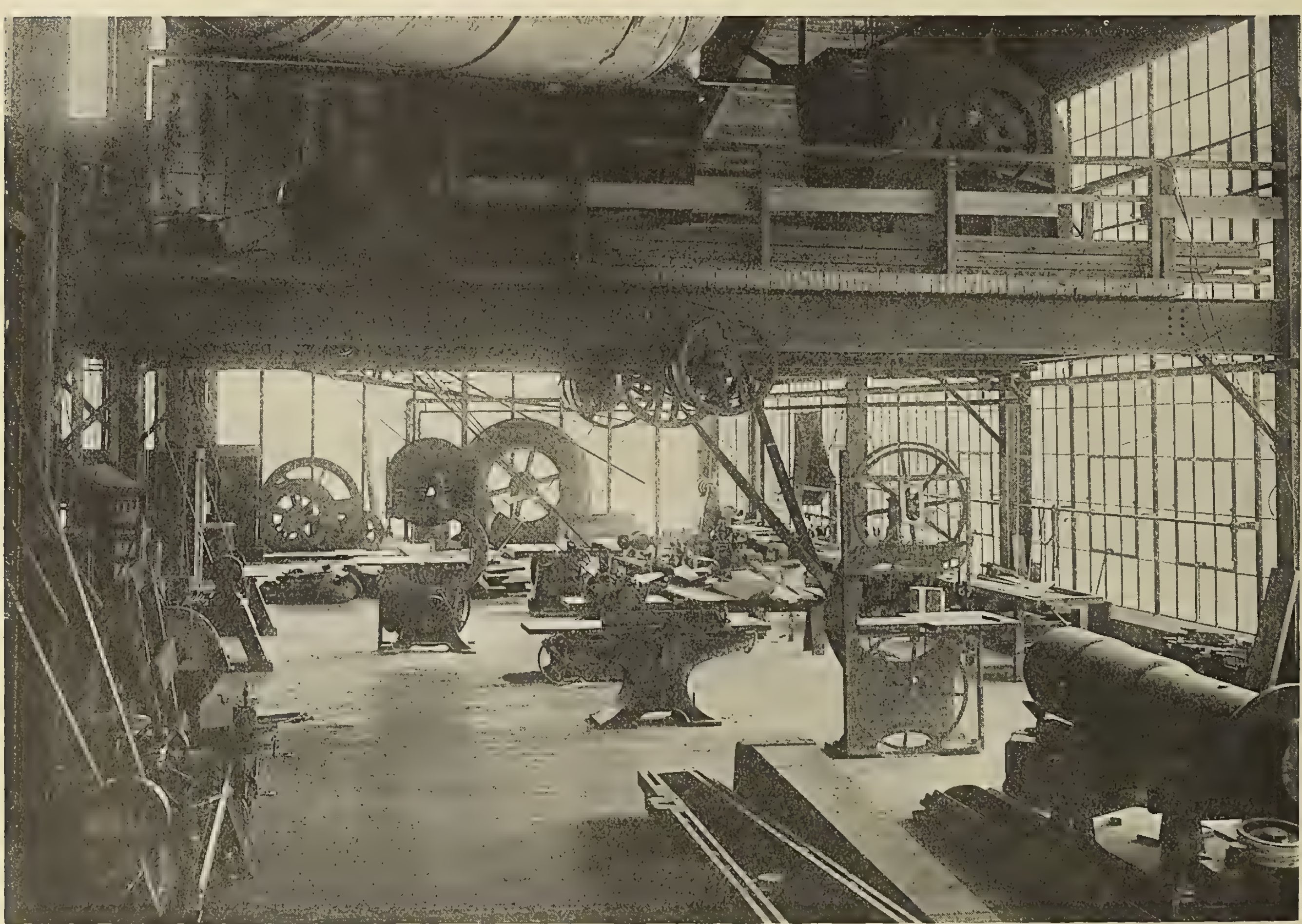


Fig. 9.—Pattern Shop

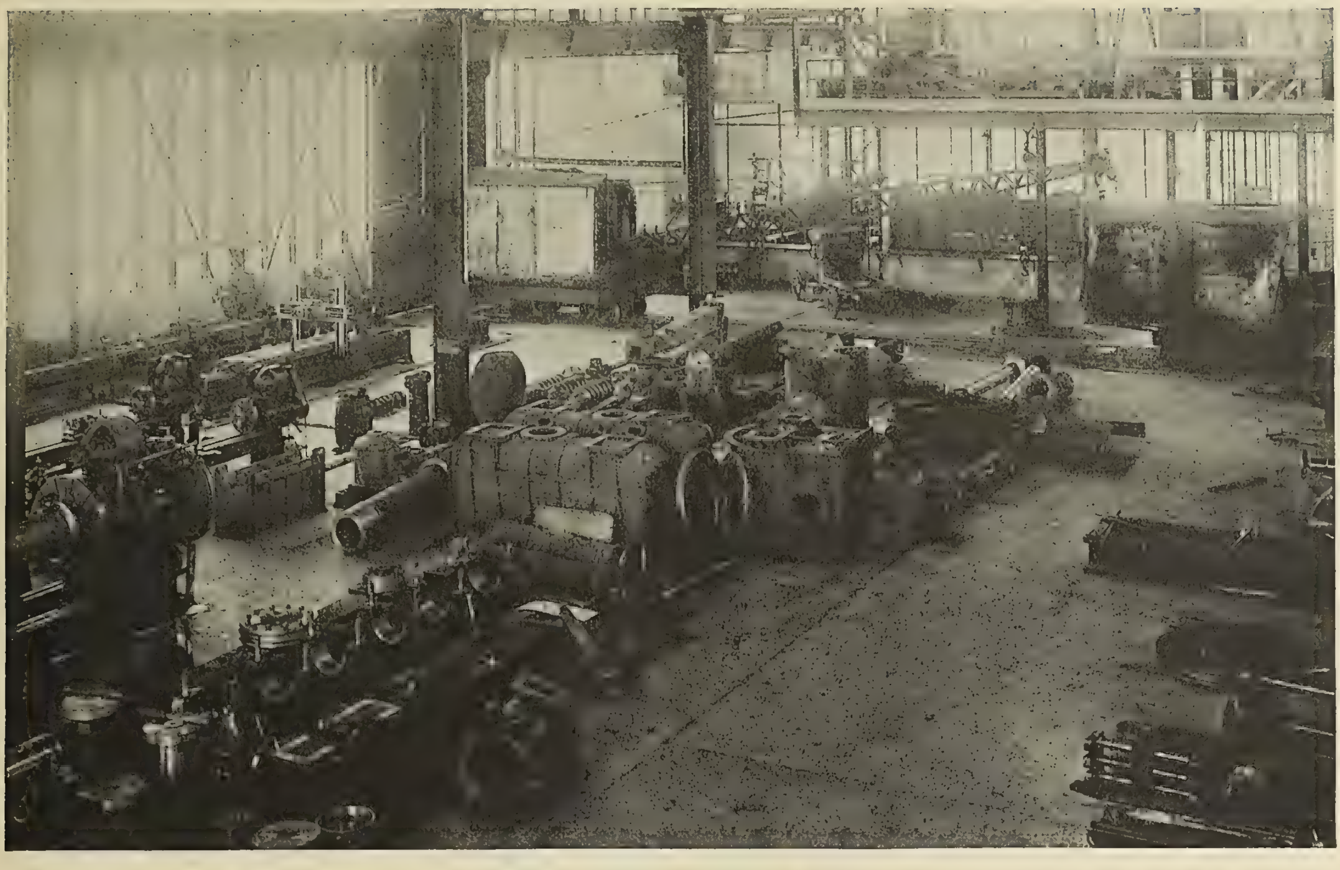


Fig. 10.—Corner of Machine Shop

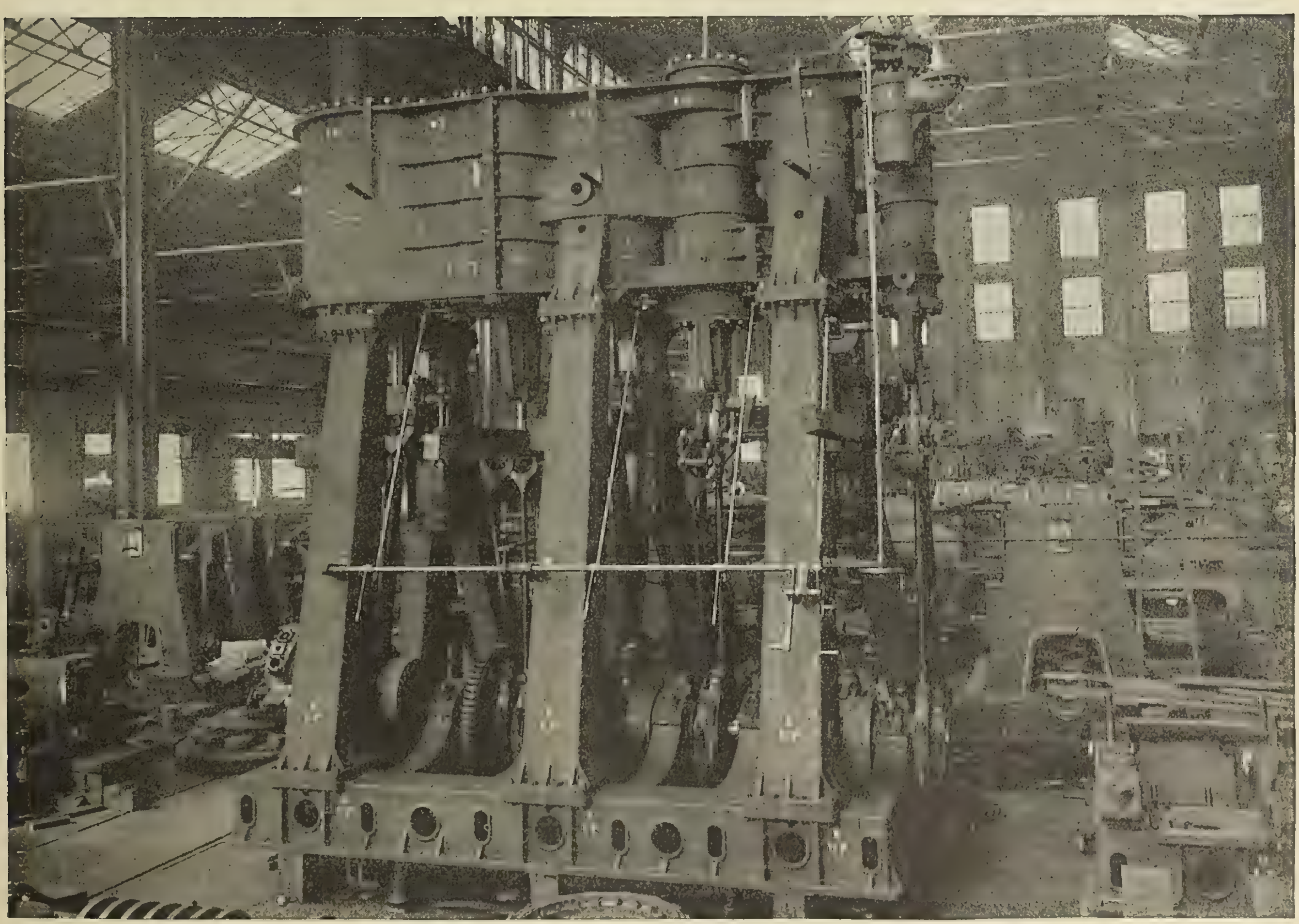


Fig. 11.—Erection Floor of Machine Shop

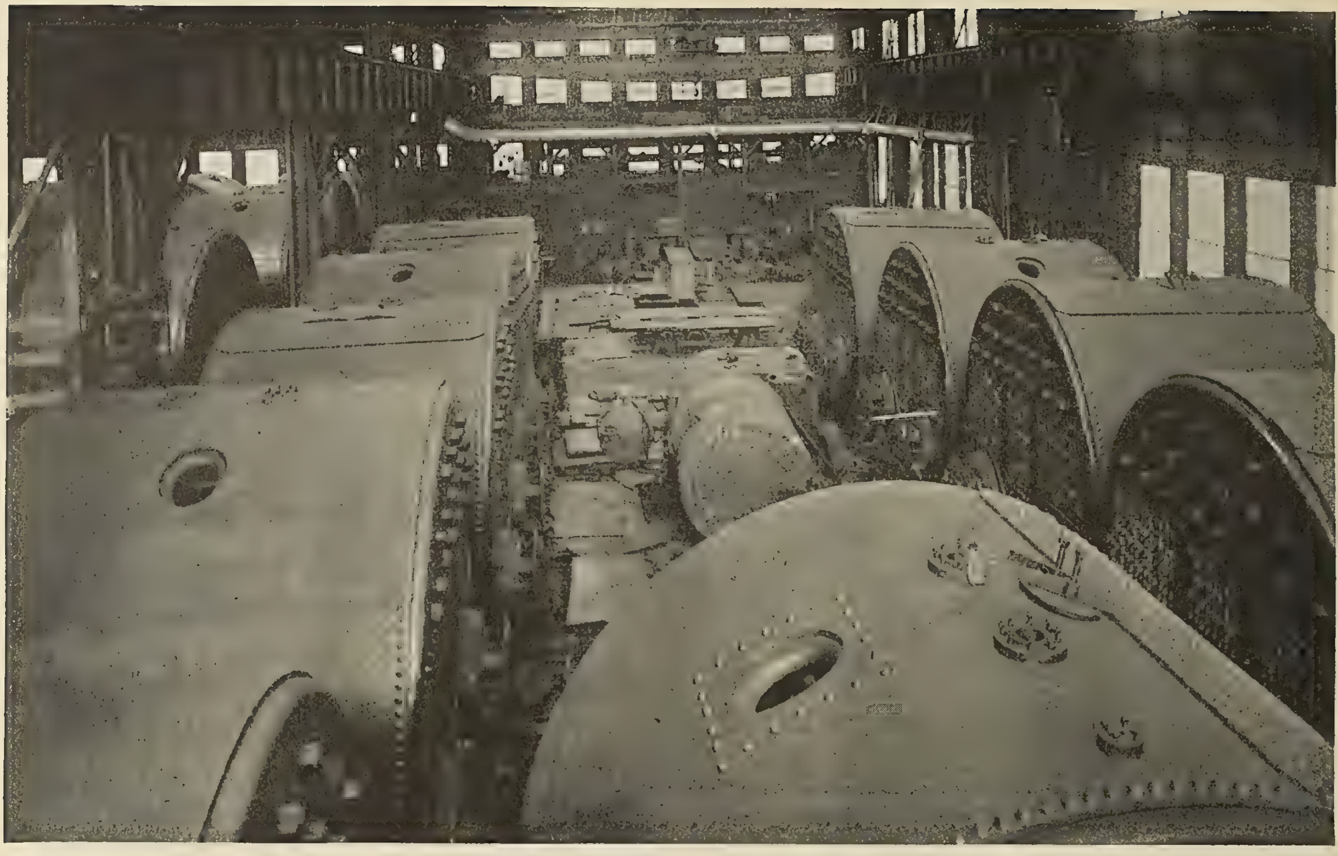


Fig. 12.—Erection Floor of Boiler Shop

Fig. 13.—Central Bay of Boiler Shop

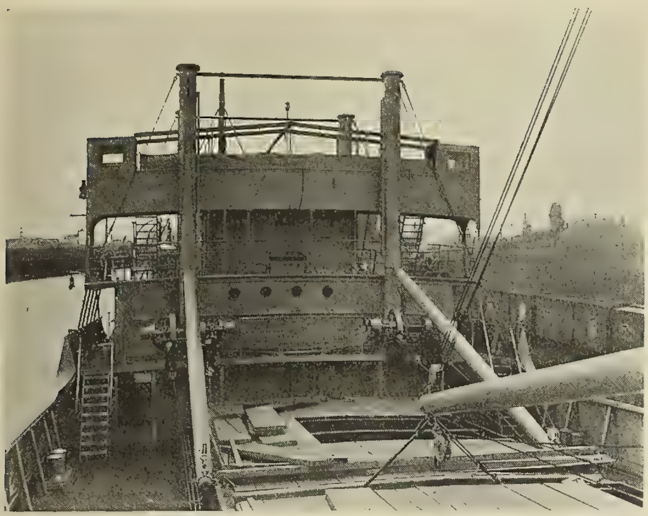


Fig. 14.—Deck of Motorship Amidships

Fig. 15.—Deck of Motorship, Looking Aft

soms, small tanks and floors are assembled in the assembly shop or on the ground.

Equipment of Machine Shop

One of the finest shops in the plant is the new machine shop, 224 feet long and 124 feet wide, of steel frame construction with glass sides. This shop is divided into three bays. The center bay is equipped with a 15-ton Pawling & Harnischfeger overhead electric traveling crane and is used for the assembling floor as well as for the largest machines in the shop. The north bay is used for the large lathes, planers, milling and boring machines, which are served by jib cranes and, where necessary, with air hoists. The south bay, with a gallery above, is used for light machine work. At the east end of the building a width of 35 feet is used for tool and locker rooms and offices. Above this is a gallery, which is used for the pattern shop.

The assembly shop, 300 by 60 feet, with the mold loft above, is of the same type of construction as the machine shop.

The blacksmith shop, located near the plate shop, is equipped with three steam hammers, one of 2,500 pounds, another of 1,500 pounds, and a third of 600 pounds, a 350-pound electric hammer and two light air hammers. The pneumatic forging hammer is especially useful for light work, such as drift pins, chisels, etc.

All of the rivets used at the plant are made with two Ajax machines in a special shop arranged for that purpose.

Two well-equipped tool rooms are provided, one for the repair of pneumatic tools in the yard and the other in connection with the machine shop.

Repair Facilities

In addition to the building of ships, the company has previously handled a large amount of ship repair work, and for this work has two dry docks, one a steel sectional floating dry dock, built at the yard four years ago, having a capacity for docking ships 420 feet long, and the other a graving dock 337 feet long.

Another important feature of the plant is the boiler shop situated a mile down the river, where the equipment is ample for turning out two large Scotch boilers a week. The boiler shop is also engaged in a variety of heavy plate work, such as paper-making machinery, digesters, tanks, etc.

The main offices of the company are located in a three-story brick building in the yard. On the first floor are the

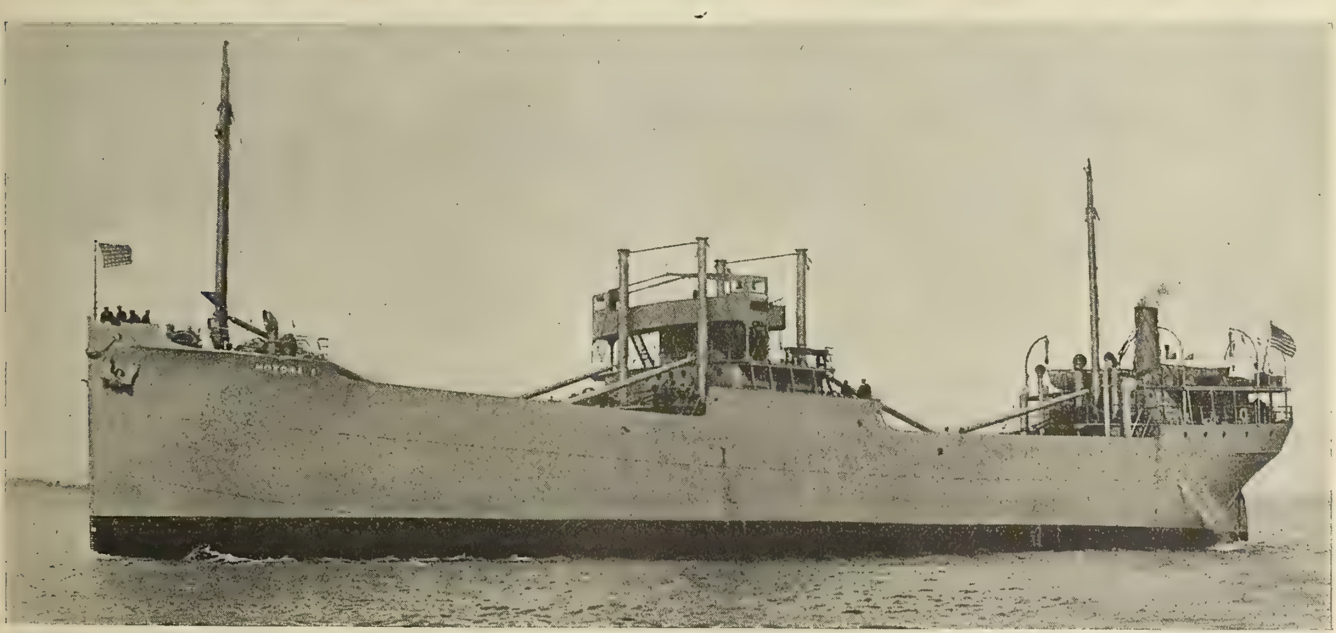


Fig. 16.—Motorship Built by Manitowoc Shipbuilding Company

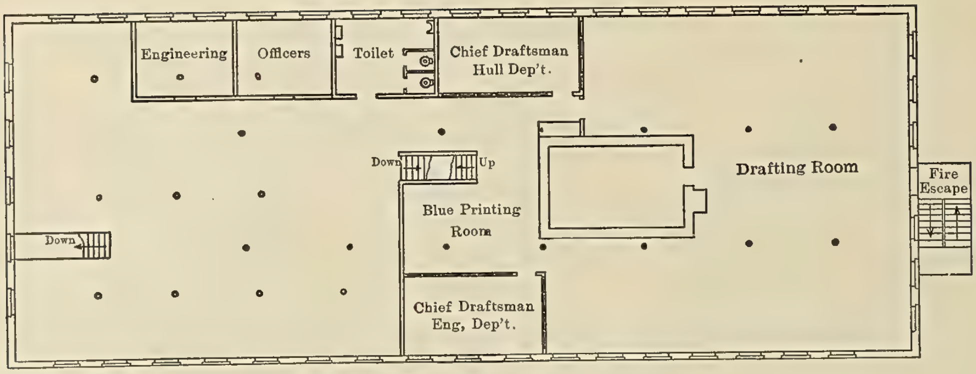


Fig. 17.—Third Floor of Main Office

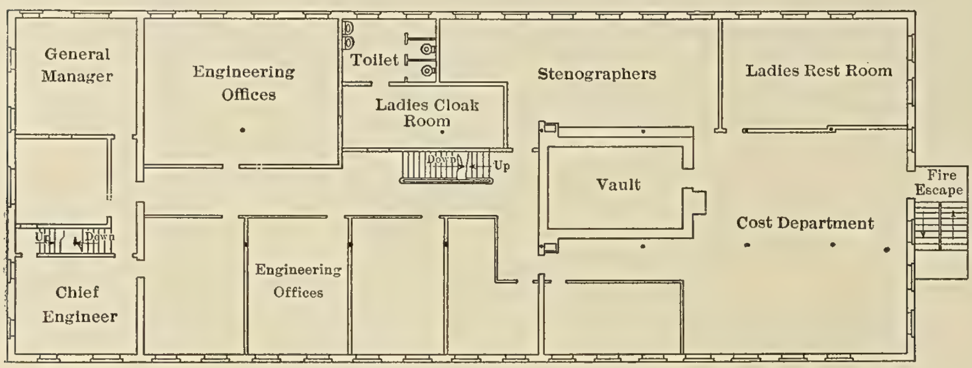


Fig. 18.—Second Floor Plan of Main Office

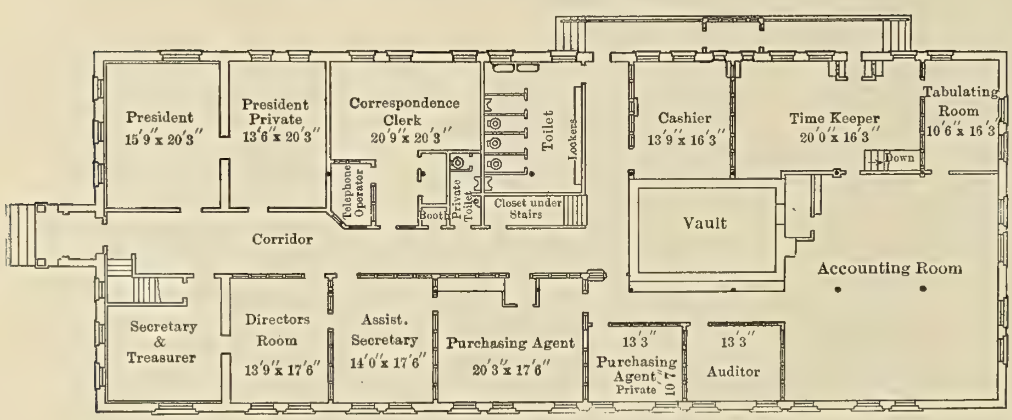


Fig. 19.—First Floor Plan of Main Office

administration and auditing offices, on the second floor the engineering department, offices for the Government officials and the stenographic department. The drafting rooms are on the third floor.

All of the workers in the yard, except the office force, are hired by a central employment department, and labor requirements receive first consideration at a weekly foreman's meeting, presided over by the president of the company. There is also a director of industrial relations. To promote safety, there are regular monthly inspections by three committees—a general committee, a foreman's committee and a workman's committee.

For protection against fire the plant is exceptionally well equipped. Water mains and hydrants are installed in the vicinity of all the buildings, as well as around the shipbuilding berths. The following buildings are equipped with automatic sprinklers: Administration building, general storehouse, machine shop, machinery warehouse, pipe and plumbing shop, rigging loft, carpenter and joiner shops, tin and lifeboat building shop, and lumber storage building.

Welfare and Housing

As a part of the welfare work, there is a completely equipped first aid hospital with a doctor and nurses in attendance and an employees' service club, which publishes a live house organ, *The Keel Block,* and supervises recreations and amusements. The housing problems occasioned by the rapid increase in the working force have been handled by the company in conjunction with the housing division of the Emergency Fleet Corporation. A hundred houses for workmen have been built by the Emergency Fleet Corporation and sixty more by the company, forming an industrial town, called Riverview, near the shipyard. In this connection the company has erected at the entrance to the yard a splendidly equipped restaurant with a capacity of 600 and a dormitory containing 245 rooms, known as the Riverview Inn. Above the restaurant is a recreation room for occupants of the dormitory. The dormitory itself is a two-story building constructed with three wings, so that all of the rooms are outside rooms. On each floor are splendidly equipped baths and showers, and the dormitory is operated with the sole view of providing comfortable and convenient quarters for the workmen.

During the past two years all of the resources of the Manitowoc shipyard have been placed at the disposal of the Emergency Fleet Corporation, and all of the vessels constructed have been of the standard Great Lakes seagoing type of cargo ship of 3,500 and 4,050 tons deadweight. Before the war, the company had built a great variety of steam vessels, including Lake passenger and cargo steamers, steam trawlers, a Coast and Geodetic Survey steamer, motorships and hydraulic and dipper dredges.

Centennial of First Transatlantic Voyage by a Steamship.—The first steam vessel to cross the Atlantic was the American-built vessel *Savannah.* This historical voyage was begun on May 22, 1819, from Savannah, Ga., and ended at Liverpool, the time required for the voyage being just twenty-five days. The vessel was of 350 tons, fitted out as a sailing vessel, but with arrangements for the installation of a 90-horsepower steam engine driving two paddle wheels.

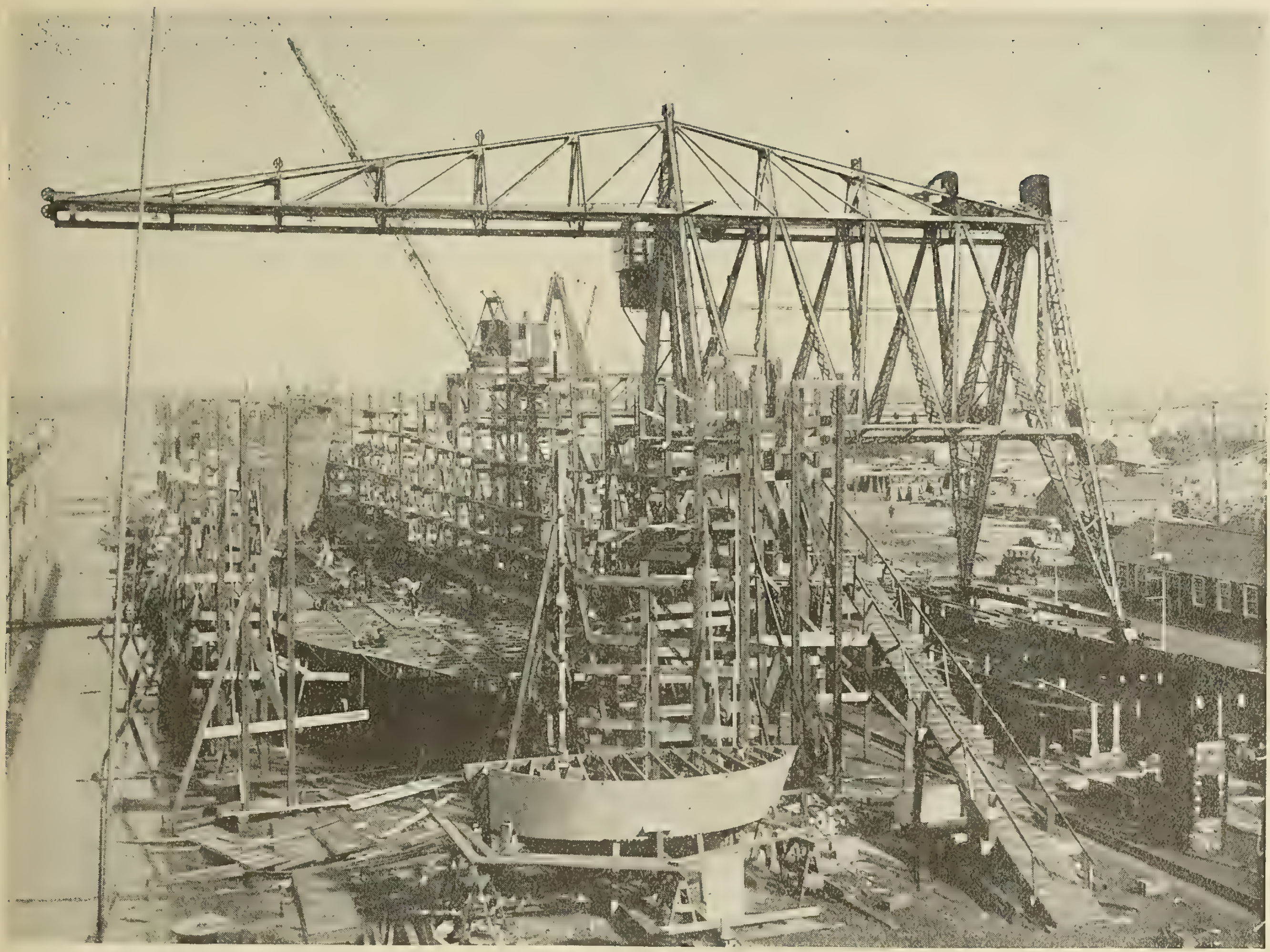


Fig. 1.—Gantry Erection Crane at Ecorse Yard

The Great Lakes Engineering Works

Detroit Company Which Operates Two Shipyards and Large Engine Building Plant—Output in 1918 Nearly 120,000 Deadweight Tons

SHORTLY after Charles M. Schwab was appointed Director-General of the Emergency Fleet Corporation he called together all the shipbuilders on the Great Lakes and told them that the Great Lakes shipyards must turn out a million tons of shipping during the next year—more than double the amount which they had produced in any previous year. Negotiations for carrying out this work at first were difficult, but the spirit with which these difficulties were overcome is shown by the prompt response of Antonio C. Pessano, head of the Great Lakes Engineering Works, who said: "Mr. Schwab, we, with our works and with all the influence I can exert, will do any work that you ask us to do that is within our ability to do, and you shall fix the prices and conditions of the contract." It was this patriotic spirit and loyal leadership that promptly rallied all the shipbuilders to affirm Mr. Pessano's statement and thus enabled the shipbuilders on the Great Lakes to contribute nearly one-fourth of the sea-going tonnage produced in the United States in 1918.

How well Mr. Pessano's pledges were fulfilled is shown by the fact that in 1918 the Great Lakes Engineering Works alone delivered to the Shipping Board no less than thirty-four steel vessels aggregating 118,800 deadweight tons—an output that represented the delivery of a completed ship at the average of one every nine working days of the year. At the end of 1918 the company was ahead of its contract schedule. Further than this, the company attained a world's record in speed of ship construction by building a 3,500-ton cargo steamer, the *Crawl Keys,* in twenty-nine days after the keel was laid.

The Great Lakes Engineering Works, whose main offices are in Detroit, Mich., has two shipyards, one in Ecorse, Mich., and the other at Ashtabula, Ohio, and a large engine building plant in Detroit. The output of the two yards in 1916, 1917 and 1918 and the schedule for deliveries in 1919 are shown in the following table:

Year	Ecorse		Ashtabula		Total	
	No.	Tonnage	No.	Tonnage	No.	Tonnage
1916	8	36,400	3	12,600	11	49,000
1917	8	59,100	3	20,400	11	79,500
1918	24	84,800	10	34,000	34	118,800
1919	29	119,400	15	61,800	44	181 200

To secure the increased output demanded during the war, the shipway capacity at the Ecorse yard was increased by a third and the crane capacity at the ways more

than doubled. A new fitting-out berth with the necessary crane equipment was also added to this yard, greatly increasing the facilities. At the Ashtabula yard, where in 1916 there were only two building berths served by a single gantry crane, another building berth and another crane have been added, while still another building berth will be available this year.

Plans of the two yards are shown in the illustrations with this article. The Ecorse yard was built in 1903 and its first keel laid in January, 1904. The Ashtabula yard was built in 1911 and its first keel laid in October of that year. The first property purchased by the Great Lakes Engineering Works, when the present company was formed in 1902, was the Hodge Marine Engine Plant in Detroit, which is now the Rivard street engine building plant of the company and comprises a machine shop 240 feet by 82 feet, a foundry 312 feet by 86 feet, and an erecting shop 110 feet by 60 feet, besides a blacksmith shop, pattern shop and pattern storage building. This plant is fully equipped for building not only the propelling machinery but also many of the auxiliaries for all types of steam vessels. The machine and erecting shops are equipped with 35-ton overhead electric traveling cranes.

The Ecorse shipyard, which occupies a site about 65 acres on the Detroit River, has eight building berths located along the sides of two slips, one of which is 820 feet long by 150 feet wide, and the other 800 feet long by 109 feet wide. A third slip, over 2,000 feet long and 240 feet wide, at one side of the yard is used as a fitting-out basin. There is also a steel sectional floating dry dock at this plant, 785 feet long overall and 107 feet wide outside the wings.

Material is handled at the building berths by eight erection cranes. Three are gantries with a lifting capacity of 7 tons over the centerline of the ships and 3 tons at the outer ends of the arms, which have a reach of 80 feet. The other cranes are of the locomotive type mounted on traveling towers 44 feet high and with a reach of 76 feet from the inner rail. At the fitting-out berth, heavy weights are handled by a set of 100-ton sheer legs, and the lighter weights by a 15-ton locomotive crane with a maximum reach of 76 feet. For handling material throughout the yard there are six steam-driven, oil-burning locomotive cranes.

At the head of the building ways are grouped the principal fabricating shops. The storage yard in the rear of the plate shop is served by a 5-ton electric traveling crane, and the craneways in each bay of the plate shop extend

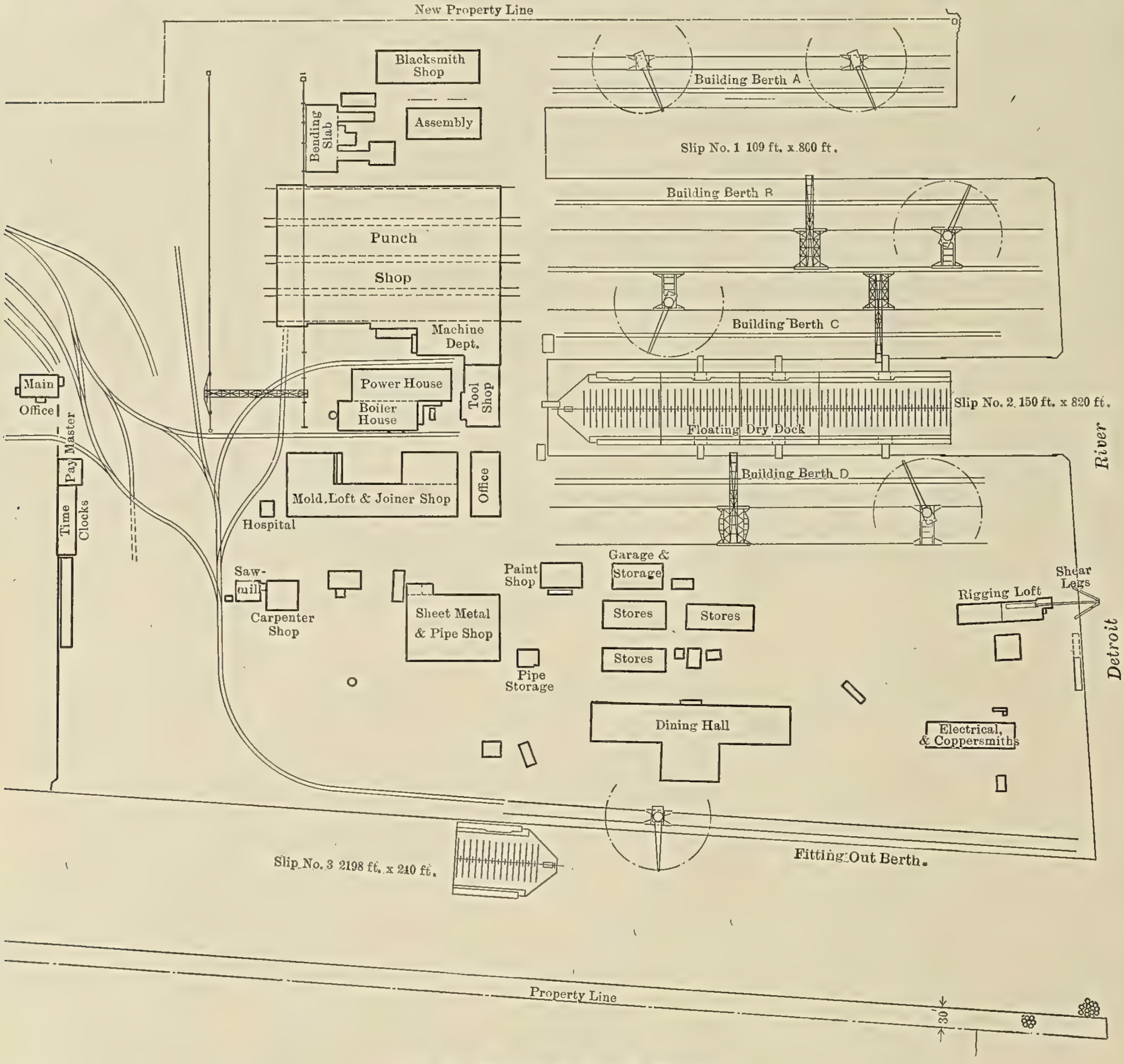


Fig. 2.—Plan of the Ecorse Shipyard

40 feet beyond the building at each end, so that material can be conveyed from the storage yard through the shop to the shipway cranes. Oil fuel is burned at the bending slab furnaces and also at the rivet furnaces and in the heating furnaces in the blacksmith shop.

The power plant contains four vertical compressors of 3,000 cubic feet capacity each and two horizontal compressors of 2,500 cubic feet capacity each. Steam is provided for heating the offices, joiner and machine shops and the mold loft.

Among the new buildings are an office for the auditing department at the gate and a dining hall 315 by 60 feet, which has accommodations for 1,500 persons at one sitting. The kitchen is in an extension 90 by 60 feet. At present about 4,000 are employed at the Ecorse yard, or about twice the number on the payroll two years ago.

At the Ashtabula yard, which is located on the Ashtabula River, the building berths, served by locomotive type cranes, are placed end to end alongside a slip at one side of the yard. The fabricating shops are conveniently located adjacent to the ways, and the material passes directly from the storage yard in the rear through the shops and onto the ways. The plate shop, 310 feet long by 60 feet wide, is divided into two bays, each served by two 5-ton cranes. Outside the plate shop is an assembly space served by a 5-ton crane.

Facilities for repair work are provided at this yard, including a graving dry dock 650 feet long and 72 feet

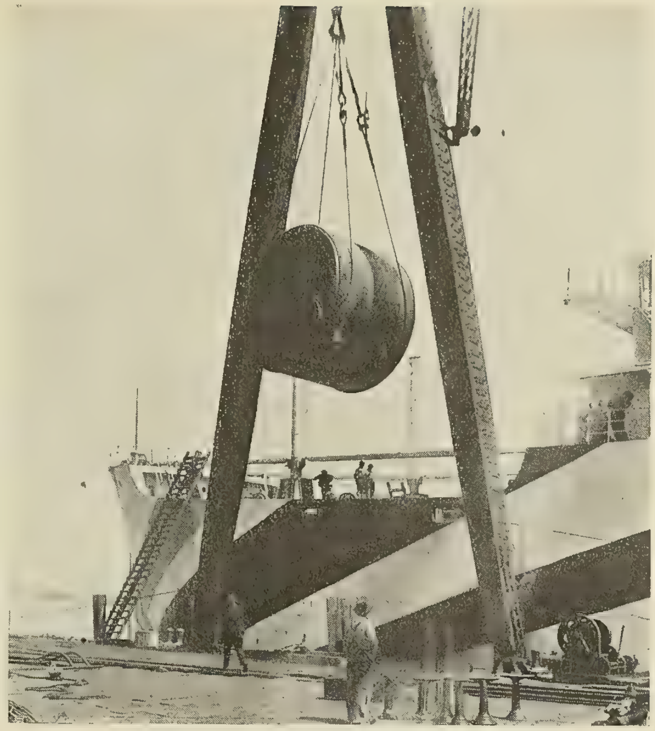


Fig. 4.—Sheer Legs at Fitting-Out Berth

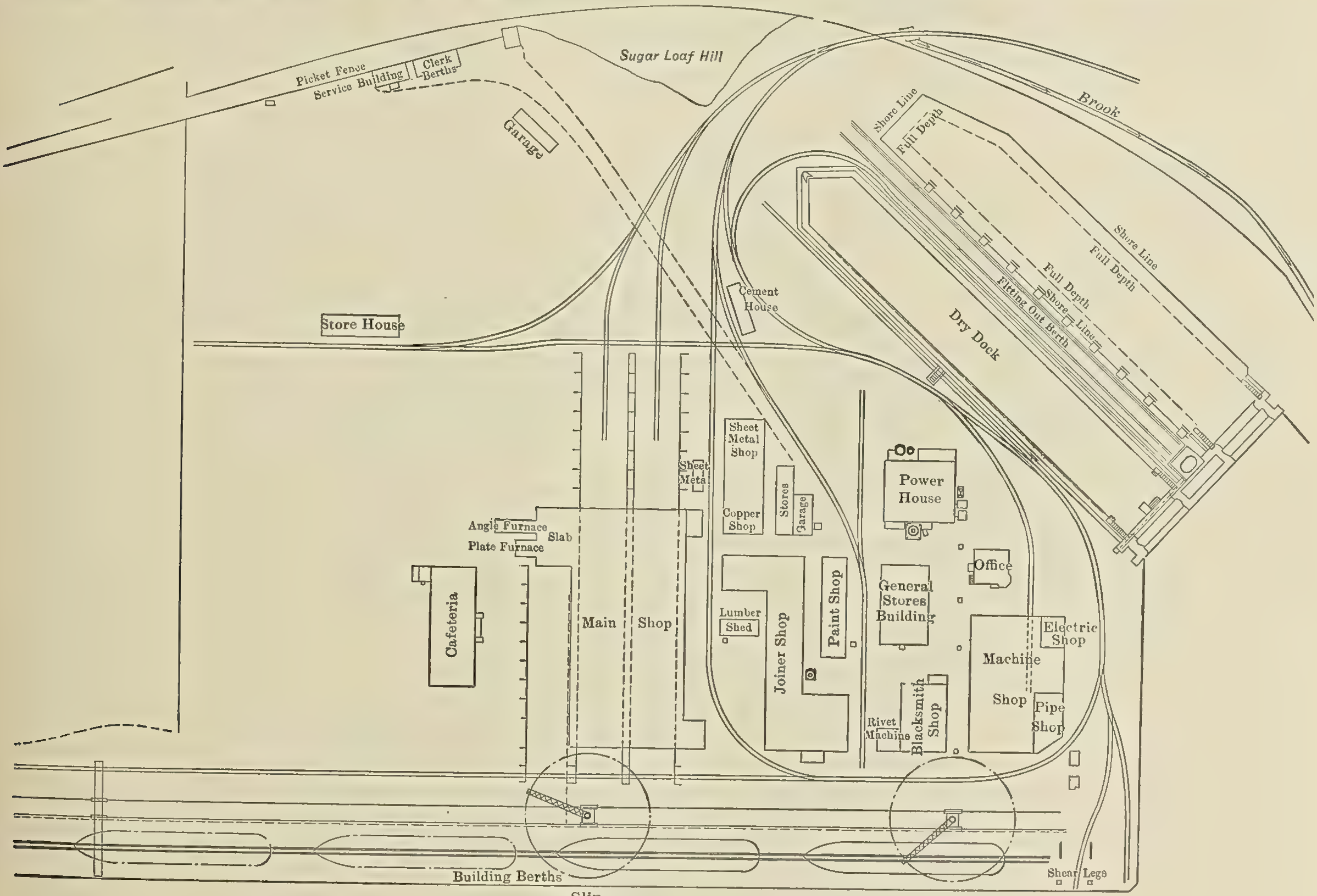


Fig. 3.—Plan of the Ashtabula Yard

wide with a depth of water over the sill of 16 feet. Alongside the dry dock is a fitting-out slip. A locomotive type crane, which is a duplicate of the one at the fitting-out berth at the Ecorse yard, serves both the fitting-out slip and the dry dock. For lifting heavy weights, a set of 75-ton sheer legs is provided.

The power plant includes one vertical air compressor of 3,000 cubic feet capacity and two horizontal compressors of 2,500 cubic feet capacity each. Gas is burned as fuel in the power house and in the furnaces at the bending slab.

About 1,700 workers are employed at the Ashtabula yard, or about twice the number employed two years ago.

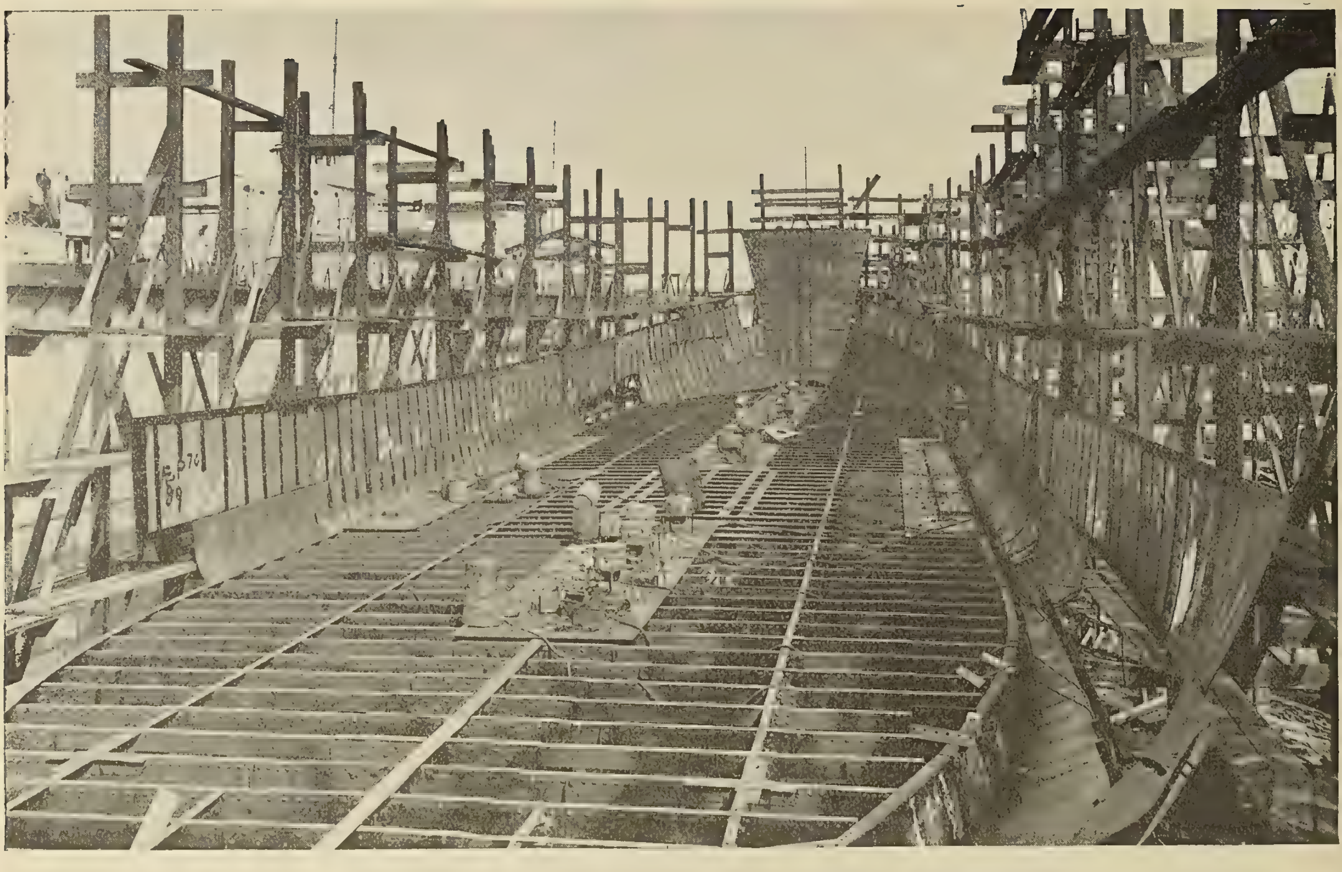


Fig. 5.—Bottom Plating, Floors, Longitudinals and Margin Plates Riveted

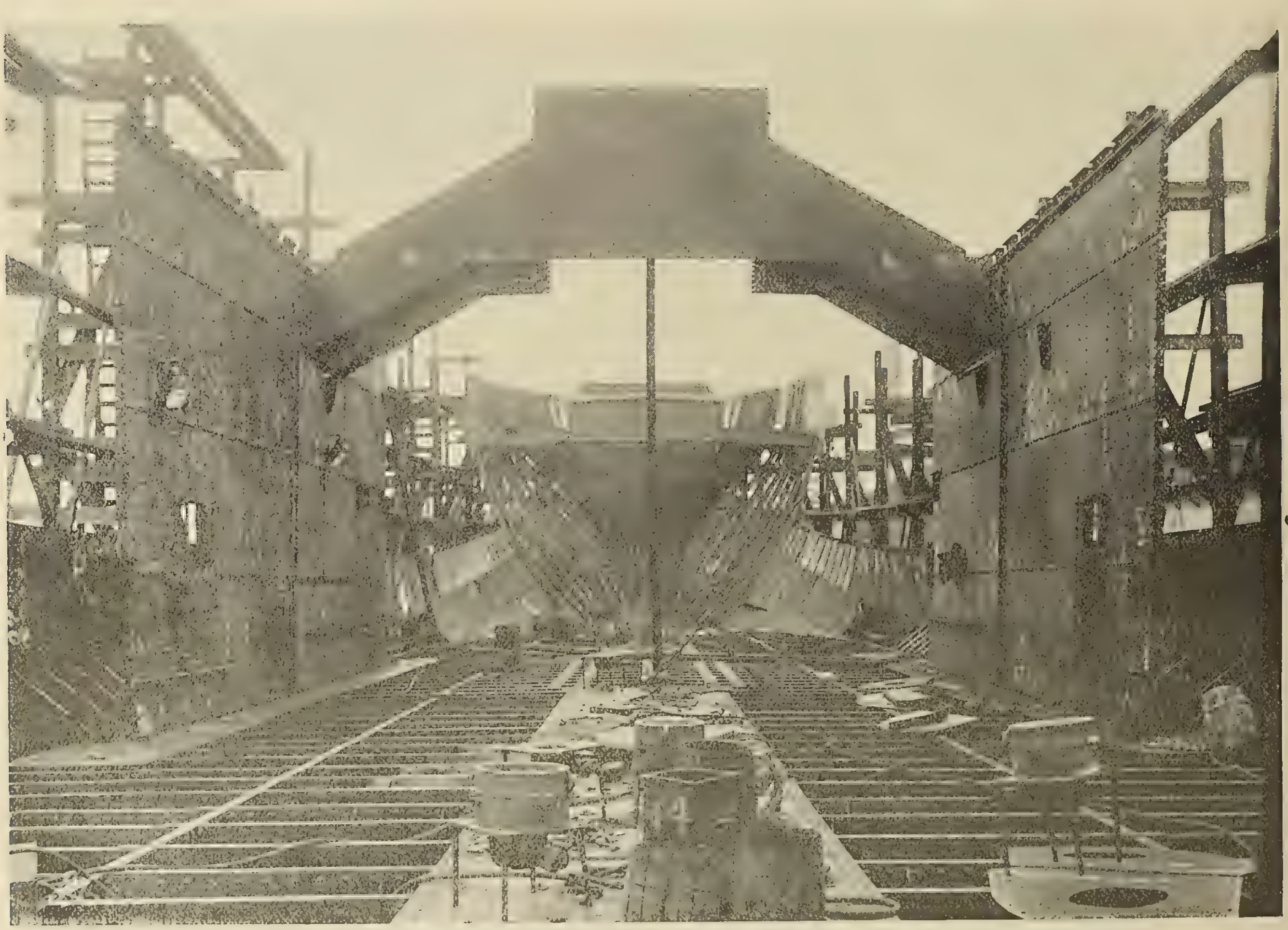


Fig. 6.—Framing Begun and Coal Bunker Bulkheads Erected

Fig. 7.—Tank Top Laid and Transverse Bulkheads in Place

Fig. 8.—Side Plating and Deck Beams Being Bolted Up

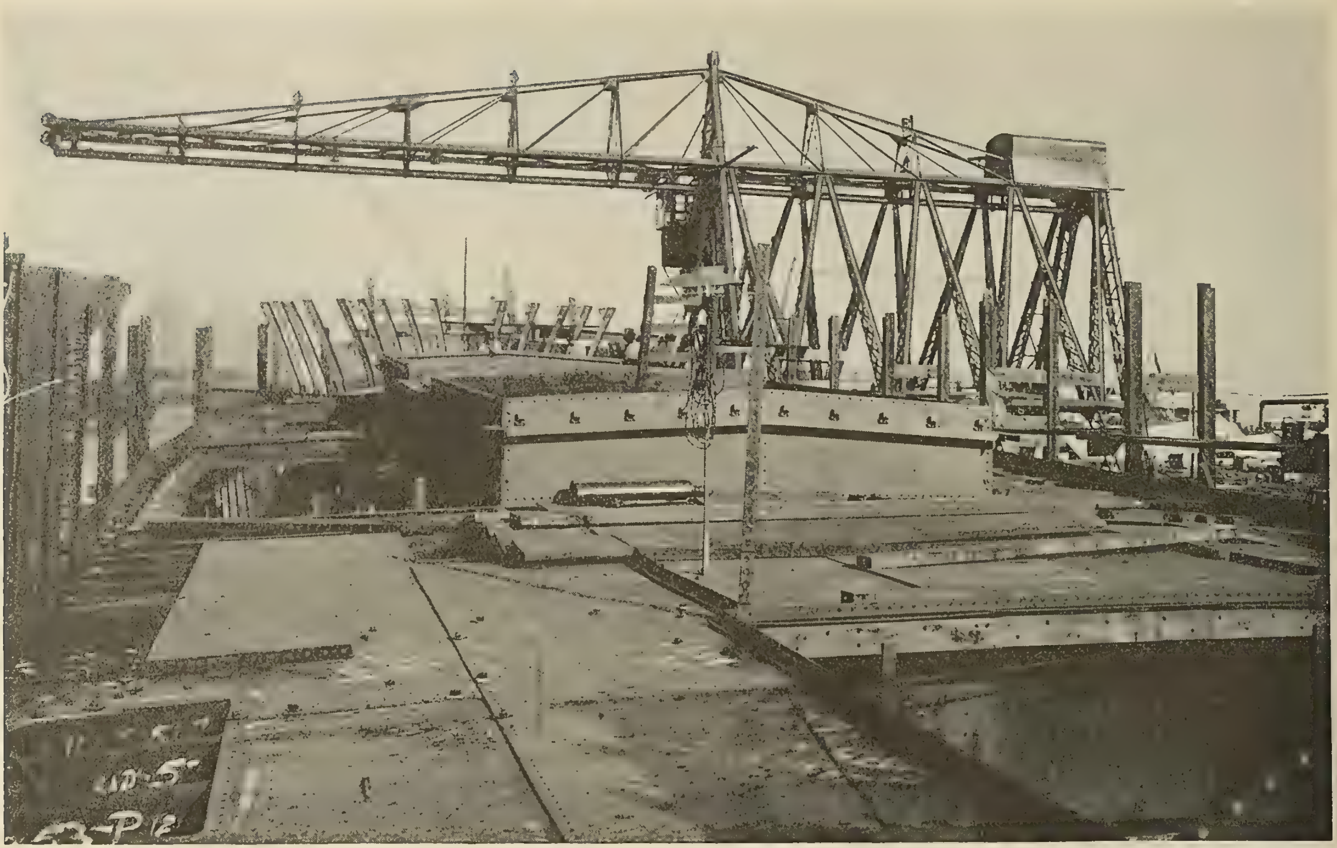


Fig. 9.—Laying the Deck Plating and Erecting Hatch Coamings

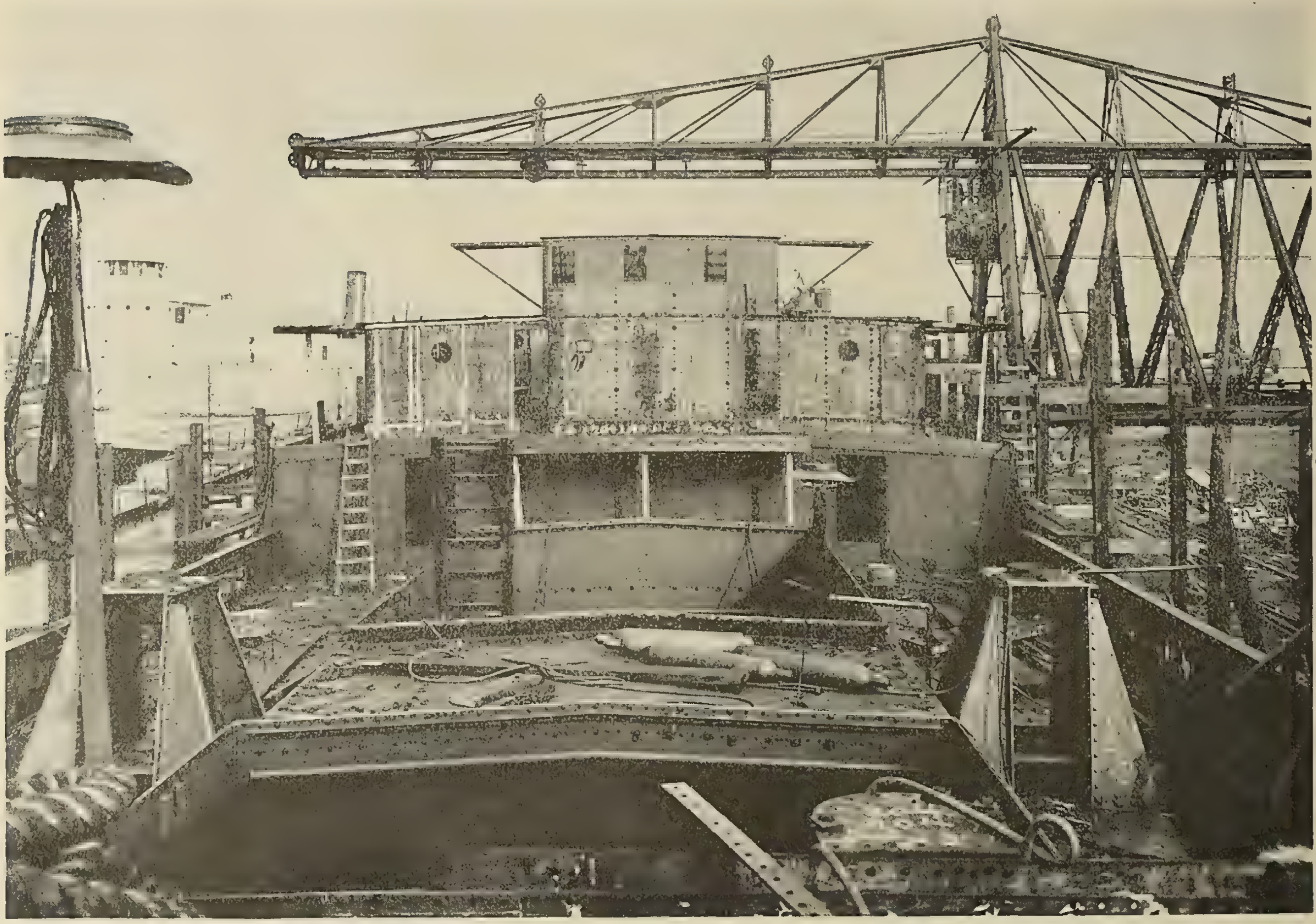


Fig. 10.—Deck Houses and Superstructure Erected

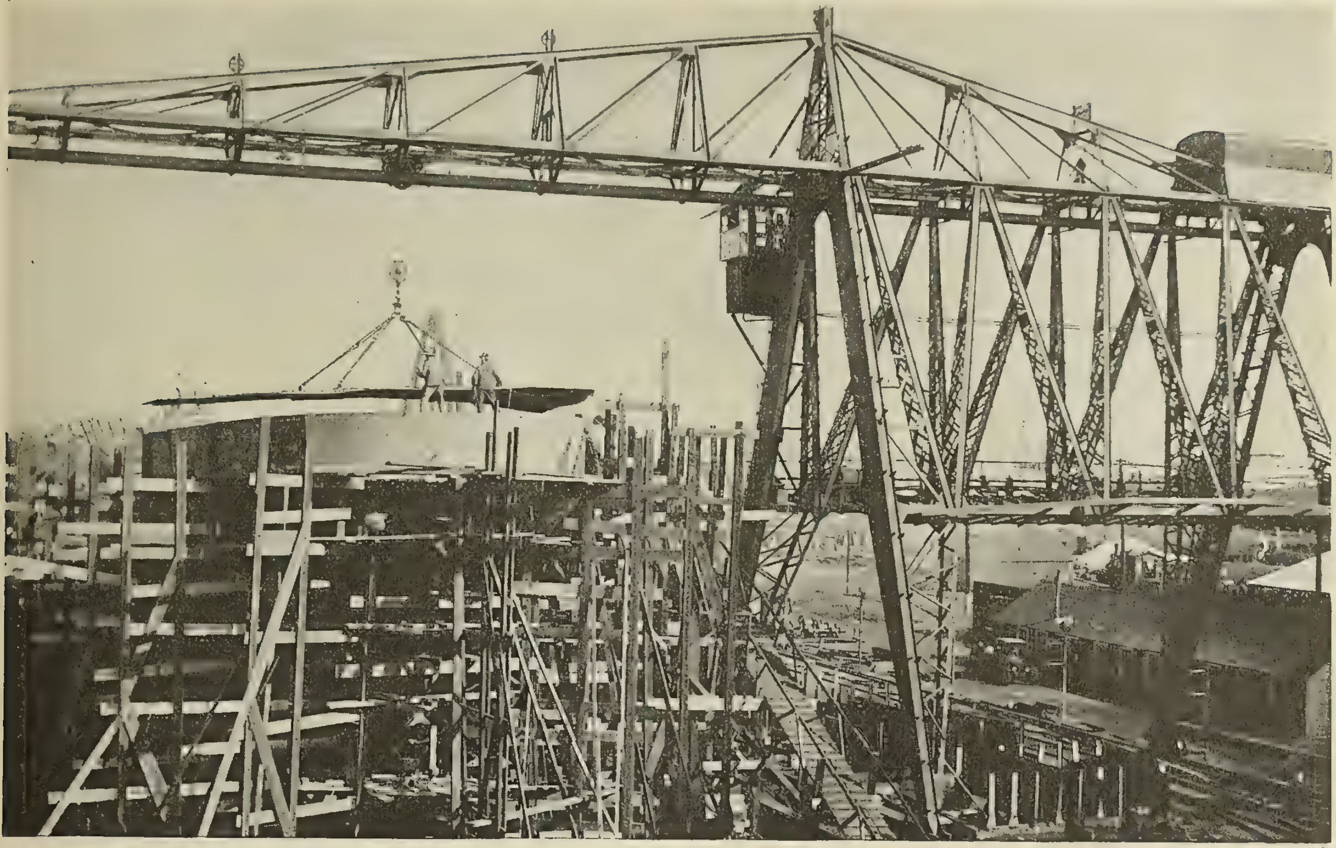


Fig. 11.—Section of Plating Assembled on the Ground Hoisted Into Place by Gantries

Fig. 12.—Ground Assembly Plays an Important Part in Rapid Construction at the Great Lakes Engineering Works Yards

Fig. 13.—Launching the *Crawl Keys* 14 Days After Laying the Keel

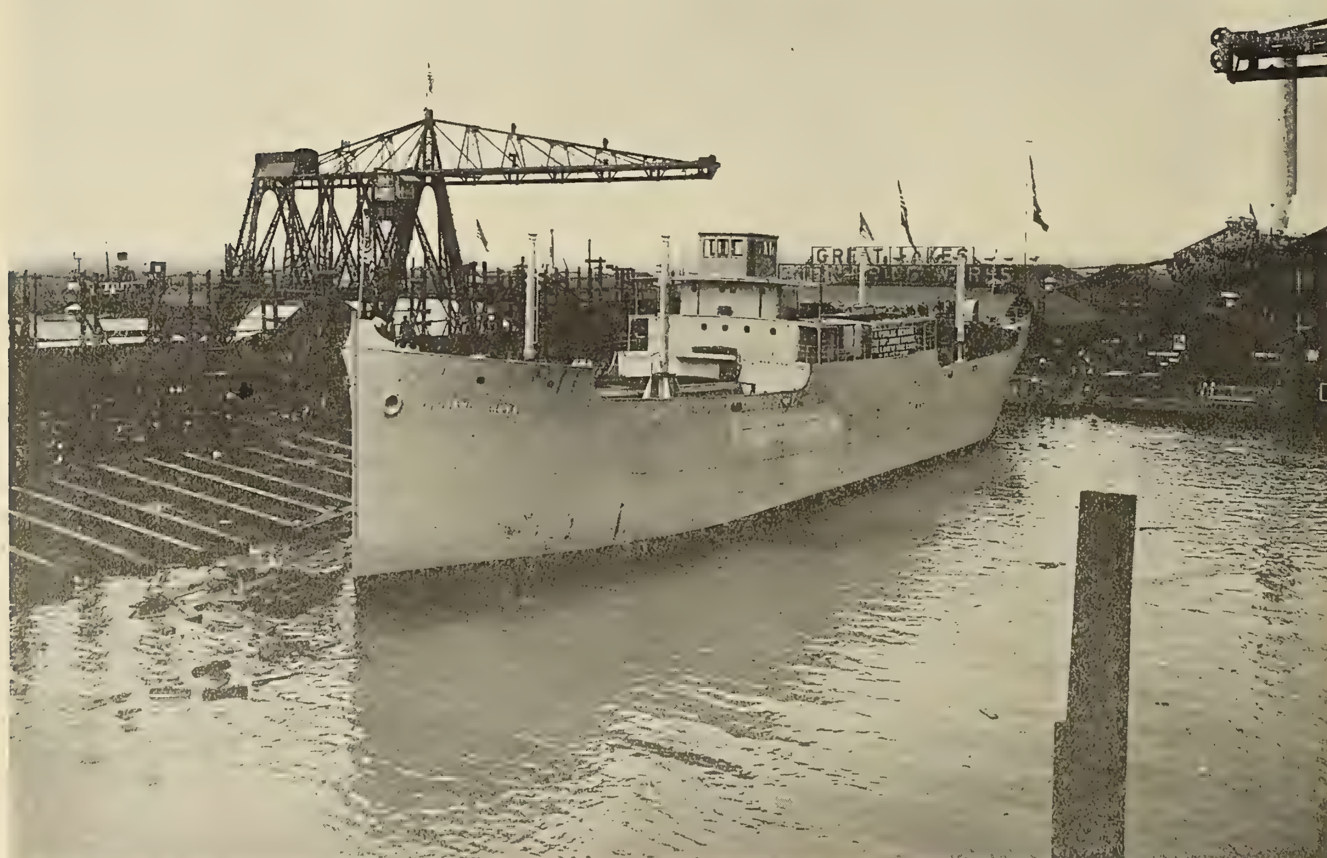


Fig. 14.—S. S. *Crawl Keys* After Launching. The Vessel Was Completed in 29 Days

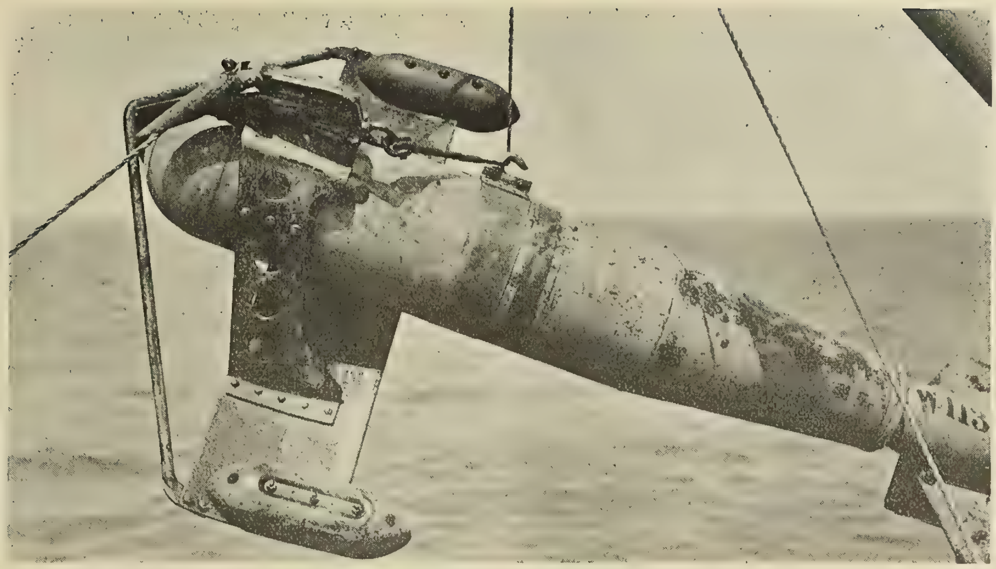


Fig. 1.—The Paravane Rigged for Action

The Mysterious Paravane

The Invention That Countered the German Mine and Saved Many an Allied Vessel from Destruction

BY WILLIAM WASHBURN NUTTING

MANY of the clever devices produced under the stimulus of war are already pretty generally known. Others are not known at all, or else exist merely as names in a strange, new war vocabulary. The tank, for instance, has become a household word, while the paravane, which shares with it the distinction of being the most important of the war's big crop of inventions, is practically unknown.

The paravane or "P.V." or "otter," as it is variously known in the nomenclature of the Allied navies, is the thing that foiled the German mine. Nearly four thousand vessels were equipped with the gear by the British alone, and of this vast number there is no record of the destruction of a single ship by a moored mine. Several hundred American vessels were equipped before the signing of the armistice, and the programme was to have included practically every ship of the Navy and merchant marine. This would have meant an expenditure of ten million dollars (£2,050,000). In saving one of our first-class battleships from destruction, however, the paravane justified itself and the ten million in one stroke.

That some new device had been perfected which permitted Allied ships to traverse mine fields, theoretically deadly, with impunity has long been guessed, but the jealous care with which the secret was guarded kept the details of the gear from the Germans to the last. Many and varied were the explanations of certain odd devices rigged on the bows of an ever-increasing number of naval and merchant vessels, and ludicrous indeed were the stories of the strange winged torpedoes which were likewise carried. This, we believe, is the first time that an authentic description of the device has been published, except in the leaded confidential books of the Navy.

Paravanes and the gear for handling them were perfected during the first two years of the war at the dock yard at Portsmouth, England, and in some quarters they are still known as the Burney gears, after Commander Burney of the British Navy, the inventor. The primary object of the paravane is the protection of ships against moored mines, although there is another type, the mysterious and deadly "Q," which is explosive and which was used with telling results against the submarine. But the protective type is by far the more important. This type is divided into three subdivisions, according to the speed of the vessel on which it is used.

How the Paravane Works

A glance at the diagram will give an idea of how the gear works. A pair of the otters, which act on the same principle as kites, is towed from the forefoot of the vessel. These stand well out, forming, with their tough steel towing ropes, a huge wedge. The length of these towing ropes varies somewhat with the length of the vessel, but is, roughly, in the neighborhood of 150 feet. These wires encounter the mooring wire of the mine and deflect the mine, and frequently its mooring as well, clear of the vessel, the mine wire sliding out along the towing rope and into the cutter head of the paravane, where it is severed by serrated steel knives. When the mine rises to surface it is exploded or sunk by gun fire or reported to a patrol vessel.

The body of the otter, which is of steel, is much the same shape as a torpedo, although somewhat shorter. It is watertight and has a positive buoyancy of about ninety pounds, which is sufficient to support half the weight of its towing wire and still bring it to the surface in case the ship stops. A large steel plane, cambered like the wings of an aeroplane, is attached as shown in the illustrations. When the otter is in action, this plane assumes a vertical position, pulling the paravane out away from the ship and exerting sufficient tension on the towing rope to deflect the mine. It will be noticed that there are two bulbs on the ends of the plane. One of these is a loaded steel shell, which gives the otter the proper list to cause it to assume quickly its normal position, even when starting from rest.

Fig. 2.—Swinging the Paravane Over-Sides

The other is a wooden duplicate of the first, placed there not so much for buoyancy as to make the structure symmetrical and to equalize the steering effect, which would be thrown out of line if the shell alone were used.

Device to Hold Paravane at a Constant Depth

In order to be sure of picking up the mine, which is ordinarily moored a couple of fathoms beneath the surface, the paravane must be made to run at a constant depth. This is accomplished by means of a horizontal rudder in the tail, operated by a hydrostatic valve placed in the joint between the tail and the body of the otter. The water pressure acting on the after face of a rubber diaphragm is backed up by a spring on the inside; the compression of this spring may be regulated to cause the otter to maintain any desired depth. When the otter dives, the increased water pressure drives the diaphragm forward, and this motion is transferred to the rudder through a valve stem and a tiller, giving it uphelm. When the otter rises above its set depth, the water pressure falls off and the spring drives the diaphragm aft, imparting downhelm to the rudder. Consequently it will be seen that the otter cannot maintain an absolutely constant depth, but must oscillate a bit above and below the average line. It will be seen, too, that this oscillation, or "porpoising," will increase with the speed at which the otter is towed, for the reason that the greater the speed the farther will the paravane rise or sink before the hydrostatic valve has a chance to act upon the rudder.

The Action of the Mercury Oscillator

This excessive porpoising at high speeds prevents the use of the simple type of paravane just described on ships of greater speed than sixteen knots, but this, of course, would include the great majority of merchant vessels. For use on ships of greater speed, such as liners, battleships, cruisers, and the like, it was necessary to equip the otter with some sort of stabilizing device which would perform the same function as the pendulum in a torpedo. The device used—called a "mercury oscillator"—is a 6-foot tube of mercury with a diaphragm at either end through which the valve stem of the hydrostatic valve extends. This tube occupies a position between the spring and the diaphragm of the hydrostatic valve. Its own diaphragms are attached to the valve stem, imparting their effect with that of the spring and the water diaphragm.

As soon as the otter starts to dive or to rise, the head of mercury thus created causes a pressure on one or the other of the diaphragms, which, in turn, transfers it to the valve steam and thence to the rudder. This device is merely an addition to the hydrostatic valve, which works, as in the slower types, to keep the otter at approximately the right depth. The oscillator merely prevents porpoising and permits the towing of the otter at high speed. Two types are equipped with the oscillator, one for extreme speeds, such as would be attained by the destroyers and battle cruisers, and the other for intermediate speeds, such as are attained by battleships.

Towing Devices

It is obvious that, in order to protect the ship thoroughly, the otter must run at a depth not less than the draft of the vessel and that the towing point at the stem must be as low as possible. Mines are ordinarily moored a couple of fathoms below the surface. If a vessel were pitching, however, it might go over a mine unless the point of attachment of the wires was placed low. It is obvious, likewise, that the point of tow must be as far forward as possible in order not to leave any considerable portion of the bow unprotected.

The Sliding Shoe

To get the towing point as near as possible to the intersection of the stem and keel line was a problem. On ships with a deep forefoot, that is, ships which are not cut away

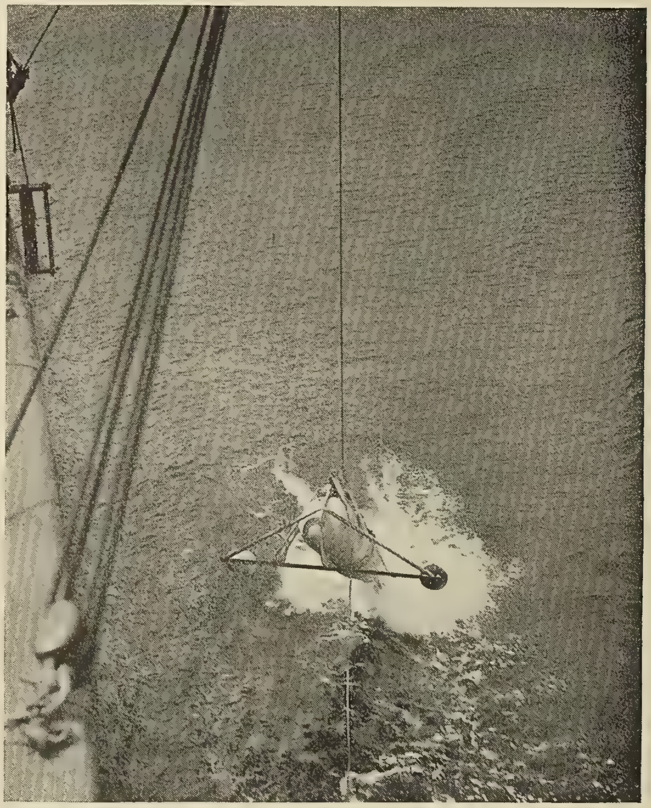


Fig. 3.—Launching the Paravane

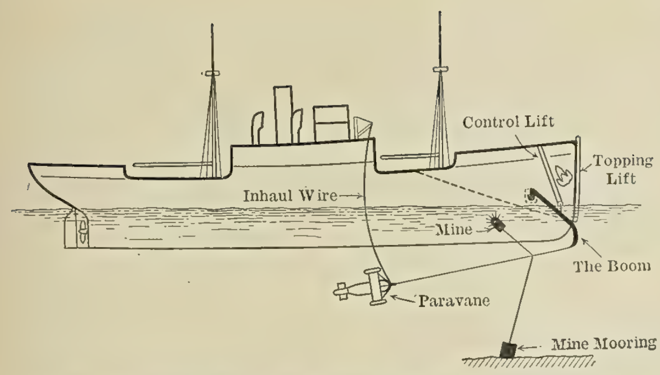


Fig. 4.—Operation of the Paravane When Towing Rope Is Held by a Boom

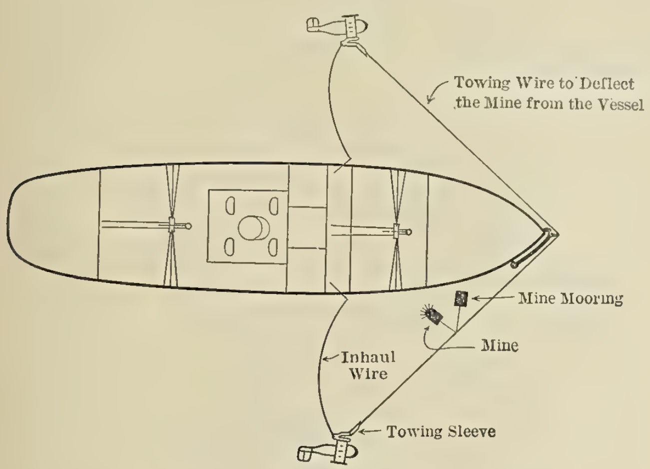


Fig. 5.—Diagram Showing Action of Paravanes

much below the water forward, it was simple enough to lower a horseshoe-shaped forging, with the towing wires made fast to either arm, down the stem. All the gear needed was a topping lift and a couple of backhauls to hold the "sliding shoe," as it was called, in place.

This was the method used on all the new vessels of the Emergency Fleet Corporation, since it was an easy matter to build out the forefoot with a "stem extension" while the vessel was under construction. But it would have been necessary to have equipped hundreds of vessels of all types—naval vessels as well as those of the merchant marine—(and most ships, especially large, high-speed vessels, are cut away to too great an extent to permit the use of the sliding shoe)—since it would not have been practicable to build in the entire cut away portion with a skeg. And so two other towing devices were perfected, one called the "boom" type, for slow merchant ships, and the other called the "clump and chains," for naval vessels and the larger, faster ships.

The Boom

Since the boom is an unwieldy piece of furniture, weighing in the neighborhood of a couple of tons, it was only used on the slower types of freighters. It is a built-up affair of forgings connected by a length of pipe and is trunnioned on the starboard side of the ship somewhat abaft the stem and a little above the waterline. The boom is so shaped that when lowered the towing point comes directly under the forefoot. A large clip on the boom engages the stem, holding it in position.

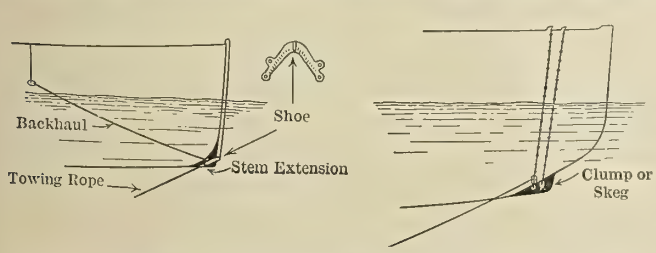


Fig. 6.—Attachment of Towing Rope with Shoe and Clump Devices

Theoretically, this arrangement is good. It is not a pleasant thing, however, to handle in a seaway and requires a lot of gear—a topping lift over the stem head, with which the boom is raised; a control lift by which it is swung around to the rail, where it is secured with chains when not in use, and a backhaul extending from the clip to a point aft on the port side. This backhaul is used to guide the boom and prevent its slatting about while it is being lowered.

The Clump and Chain

On large, fast vessels it is impossible to get the towing point exactly where it should be. The forefoot is usually cut away, prohibiting the use of the sliding shoe, and a boom of the size which would be required would be out of the question. So a skeg, or "clump," is built onto the keel as low as possible without cutting the base line. Through two large holes in this skeg two chains are rove, extending from one rail to the other. These chains are run over the bow chocks and each carries a "dumbbell" and swivel link, to which one of the towing wires is attached. The towing points are lowered by hauling in on the other ends of the chains. By attaching the ends of the chains to a single tailing wire, they may be lowered simultaneously without difficulty.

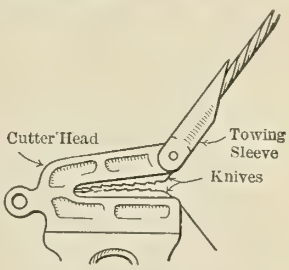


Fig. 7.—Detail of Cutting Device

The position of this skeg or clump is important. In order to prevent the possibility of the towing wires going over the mine, allowing it to come into contact with the bottom of the vessel, the skeg must be low down. This means that unless a very large skeg is used, it must be considerably aft of the stem. The placing of the skeg, therefore, is a compromise, for, when in the position just mentioned, it leaves a considerable section of the bow unprotected. But this is not so dangerous as it might at first seem, since it has been found by experiment that a mine is rarely encountered directly on the stem, or, in fact, within several feet of it. The action of the displaced water tends to throw it well to one side or the other, and the towing rope picks it up before it has a chance to strike the ship.

But let us assume that the ship did pick up a mine dead on the stem. The chances are that even in such a case it would not be greatly damaged if equipped with this gear. This is the reason: The German mine, the one with the horns, is so designed that it does not explode at the instant of contact. When a horn is bent or broken, in turn breaking the glass vial of acid which it contains, the action of the latter is not instantaneous. There is a delay of several seconds, the purpose of which is to cause the mine to explode well along the side of the vessel abreast the engine room or at some spot more vital than forward of the collision bulkhead. In such a case the towing wire would pick it up and deflect it well clear of the ship before it exploded, and the chances of serious damage would be slight.

But we need not depend entirely on theory to back us up

in this statement. Over four thousand vessels have been equipped with the otter gear, and of that great number there is no record of the destruction of a single ship by a mine, although it is definitely established that many a vessel has been saved by the gear.

Launching the Otters

The otters were used—and, in fact, are still used—in all waters less than a hundred fathoms deep where mines are likely to be moored. When the hundred fathom curve is reached the towing wires are bent onto whatever towing device is used and the latter is lowered away. The towing wire is draped over a hook at the rail, called the "easing-out hook," and is held by some sort of a "stopper" to prevent the bight of wire, which is dragging in the water, from pulling the rest of the wire taut and interfering with the launching of the paravane.

When this is done the paravane is swung out on a specially provided crane by means of a second wire called the inhaul wire, which is permanently attached to the otter and drags through the water. This wire is led through a hook, as shown, in order that the otter may strike the water more nearly in its normal running position, allowing it to be launched at much greater speed. When the paravane is out over the water, the stopper, mentioned above, is cast off and the paravane is dropped. There is a tendency for the otter to dive when it is first launched, and for this reason it is allowed to tow from the easing-out hook at the rail until it has found its depth and is running steadily. Then the hook is paid out and tripped, releasing the towing wire and allowing the otter to find its position a hundred feet or more from the side of the ship.

Many ludicrous statements about the paravane have appeared recently, which only go to prove how remarkable was the secrecy with which the device was guarded throughout the war. A popular misconception is that the otter is self-propelled, the current being conveyed through a wire. Another is that the mine wire is sheared off by means of some mechanical device. The jaws in general use are stationary and contain a pair of tool steel knives with saw teeth, set at a very small angle, so that a comparatively slight pull will sever the wire cable. Any rope that will enter the jaws is cut instantly. Even ⅝-inch wire, which is much heavier than could be used on any existing type of mine, has been cut with no apparent difficulty.

The Size of the Programmes

As we have said, the Admiralty equipped in the neighborhood of four thousand vessels of all types with the otter gear, and there is no question but that this vast programme paid for itself over and over again in the vessels which were saved from damage or destruction. Soon after the United States joined forces with the Allies, an arrangement was made with the Admiralty to permit the building of the gear in this country, and up to the time of the armistice several hundred vessels of the Navy and Emergency Fleet Corporation had been equipped.

The paravane was a strange, new device to our people and was pretty generally looked upon with skepticism until its worth actually had been demonstrated. For the purpose of demonstration, and for the instruction of officers in the handling of the gear, a vessel was completely equipped and placed in commission in New York waters. She was provided with a lecture room, equipped with a motion picture machine, and worked in conjunction with a mine layer, which each day laid a couple of dummy mines for her to cut.

A vessel was, or rather still is, engaged in the testing of paravanes after they come from the factory, for those vessels already fitted are still using their paravanes, and in all probability will continue to do so until all danger of mines has been removed.

Suggestion for Building Up the American Merchant Marine

BY WILLIAM T. BONNER

If our Government is disposed to lend its capital and credit to the development of our merchant marine, it may do so by aiding private corporations to take over the entire emergency fleet and at the same time advance our commercial relations throughout the world by a very simple though extensive system somewhat as follows:

First.—Tranfer the Emergency Fleet and Shipping Board property holdings to private corporations at appraised prices.

Second.—Allow the purchasers to pay the contract amounts in ten annual instalments from earnings or capital, or both, full ownership to pass from the Government to purchasers only when payments are completed.

Third.—The Government to aid in the development of our foreign trade through the medium of a thoroughly reorganized consular service, which shall maintain a live commercial representative (non-political) in every important town in the world. Each representative should be fully informed regarding the country's resources and have a complete library of catalogues and statistics pertaining to our products of farm and factory. According to the prominence of his post, each consular agent should maintain a more or less extensive exhibit of the representative American articles of commerce adapted for use of consumption in his district.

Fourth.—The Government to plan and arrange for the maintenance of a schedule of regular sailings for American ships between each consular port and some well-selected American port, and contract with the operating company for a fixed amount of cargo space and passenger accommodation for each voyage.

Fifth.—These Government reservations to be placed at the disposition of the consular service for the free transportation of samples and exhibits outward, raw material consignments inbound, and for sending agents and commissions from the foreign consular districts to study our resources and purchase our products.

Sixth.—In addition to the consular cargo, the Government to institute a thoroughly efficient postal system somewhat similar to our railway mail service between each of its home and consular ports, which shall be an *all-American service.*

In the meantime, it is presumed a reasonably amended Seamen's Act shall have been passed, as there is little prospect that the United States will ever obtain, even temporarily, commercial supremacy of the seas under the conditions imposed by the LaFollette bill.

However active our merchant marine might be in the interest of the commercial consular service, it need not conflict with any proper Governmental function of our Navy. The training systems now conducted by the Navy might be enlarged upon for the preparation of our consular agents for their duties, as in no other way could prospective consuls secure such practical instruction and experience as that obtainable by direct contact with our naval operations. Moreover, a consular preparatory school of this sort would be closely akin to the school for diplomats which was recently proposed as an adjunct of our naval training system.

Report of the Port and Harbor Facilities Commission of the United States Shipping Board For Twenty-Two American Ports

REVIEWED BY H. McL. HARDING*

The data contained in this most valuable report, which was compiled by J. F. Lane, statistician of the Port and Harbor Facilities Commission, are capable of extensive practical application. For example, there is given the quantity of electricity available at each port for light and power, including the kind of current, direct and alternating, voltages, cycles, etc. Such facts are of service to all manufacturers of freight-handling machinery, to the port authorities and to terminal engineers preparing plans and designs for port development.

It is recognized by the commission that electric power will be extensively used for the mechanical movement of freight between the vessel and shore, and for the handling—that is, the assorting, distributing and tiering—of cargoes.

Taking, as an example, the report on Baltimore, which is summarized under many headings, the facts, with the exceptions noted below, are quite complete. The remarks concluding the statistics of this port contain statements of great worth—the mentioning of the fact that at the port of Baltimore most all the outbound freight is transferred directly from car to vessel, and other important points.

While a statement of the volume of tonnage transferred at each port, as well as the character of the freight, would have been comparatively useful, yet, with commerce in its present transitional state due to the increasing tonnage, such figures can better be given in a later supplementary report.

Baltimore is treated under the following headings: (1) Controlling depth of water to the sea; (2) Berthing capacity in linear feet, with list of piers and their areas in square feet; (3) Railway ownership and control of piers; (4) Names of railroad lines serving the port; (5) Dry-docking facilities; (6) Anchorage area available; (7) Fresh water; (8) Quantity and characteristics of electric current available; (9) Coaling facilities; (10) Fuel oil facilities; (11) Crane and derrick facilities; (12) Steamship lines; (13) Grain elevators; (14) Remarks.

As to the mechanical facilities for transferring and handling miscellaneous cargoes and package freight at the twenty-two ports covered in the report, there is practically none, although, in order that there may be items entered under this head, references are made to the privately owned facilities for bulk freight, lighter derricks and coal cranes.

The writer considers it essential that for waterborne foreign commerce, freight-handling facilities should be publicly owned. As the berthing frontages with their depths of water are given, it is possible to determine the immediate marine tonnage transferring possibilities.

It is hoped that Mr. Lane will continue these reports in relation to many other ports, as there is no doubt as to the necessity for the compilation of such information to assist in the development of the foreign commerce of the United States. Reference should be made to all ports where there is an opportunity for commercial port development, even though there is little commerce at present. Such a report would stimulate commerce.

An outline map of a plan of the physical characteristics of each port should be made a part of the complete report. The electrotypes of these plans would be readily furnished by the port authorities of the different cities.

*Consulting Engineer of the State of New York on Barge Canal Terminals.

Elevators on Mine-Laying Fleet Made Possible Steady Flow of Mines to Launching Deck

MUCH has been written and said lately about the remarkable feat of Mine Squadron One of our Atlantic Fleet in laying a barrier of mines 230 miles across the North Sea from the Orkneys to Norway. The squadron, under command of Captain R. R. Belknap, U. S. N., consisted of eight former merchant vessels converted for the special purpose of mine laying. The four vessels of the *Roanoke* class carried 860 mines each, the two of the *Quinnebaug* class 600, and the *Shawmut* and *Aroostook* 350 each, the latter all carried on one deck.

Fig. 1.—Mine-Laying Steamer *Roanoke*

Storage of the Mines

The problem of efficiently carrying the mines from their storage in the two lower decks to the launching deck was solved by installing on all ships but the *Shawmut* and *Aroostook* a system of elevators, partly of the electric type and partly of the hydraulic type. This equipment was furnished by the Otis Elevator Company, New York, and proved to be highly successful in performing their chief function, that of keeping a steady flow of mines to the launching deck during the operation of planting the mines.

Of the six ships thus equipped, four, the *Roanoke*, *Canonicus*, *Housatonic* and *Canandaigua*, were furnished with six elevators each, and two, the *Quinnebaug* and

Fig. 2.—Elevator Machinery

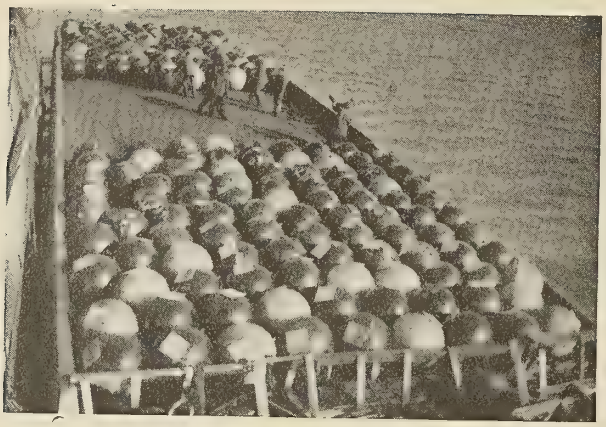


Fig. 3.—Mines Brought to Vessel on Barge

Fig. 4.—Mines Stowed in Hold on Tracks

Saranac, with four elevators each. The electric elevators were placed well forward and the hydraulics amidships and aft of the electrics. All the elevators were of 3,000 pounds capacity, thus carrying two mines on each trip.

Elevator Equipment

Of particular interest are the electric elevators. These elevators were of the "micro-drive" type, an equipment developed by the Otis Company primarily for the handling of freight in terminals, warehouses and industrial plants. They are sometimes termed operatorless elevators, from the fact that no regular operator is required, every movement of the elevators being automatic and controlled by push button operation.

A feature of great importance on this type of elevator is the automatic leveling device. By an ingenious arrangement of the machine, controller and a leveling switch operating with cams in the hatchway, the elevator platform is automatically brought to an accurate level with the floor and maintains that level under all conditions of loading and unloading.

Method of Operation

To illustrate the method of operation of these elevators on the mine-laying ships, let us assume that one of the elevators is at the lower deck ready to be loaded. The mines are stored on channel-iron tracks laid along the deck, the mine anchor being furnished with wheels to run on the tracks, which extend onto the elevator platform. As the first mine is rolled on the elevator, the stretch in the cables may cause the platform to sag a few inches below the floor level. The automatic leveling device, however, immediately brings the platform back to its proper level and the second mine is rolled on without delay.

The proper button is then pushed by the despatcher and the elevator with its load proceeds to the launching deck, where it automatically stops level with the deck. As the first mine is rolled off, contraction in the cables, due to the release of so much weight, may cause the platform to rise slightly above the deck level, when the leveling device automatically restores it to a level position and the second mine is rolled off. The elevator is then despatched to one of the storage decks by the momentary pressure of the proper button.

This continuous method of hoisting the mines made possible their planting in an unbroken line, one mine being dropped from the stern every 11½ seconds while the ship moved at a speed of 12 knots. A total of forty mines was maintained on the launching deck at all times during the planting.

During the period of the fleet's activity there was not a single instance of a break in the continuity of movement of the mines due to interruption of the elevator service.

Oxy-Acetylene Welding in Great Britain.—It is estimated that to-day not less than 30,000 employees in Great Britain are working the process of oxy-acetylene welding. Twenty thousand of these entered the field since the war began. Of the total number, 90 percent are not fully skilled, being mostly employed on sheet steel work for war purposes.

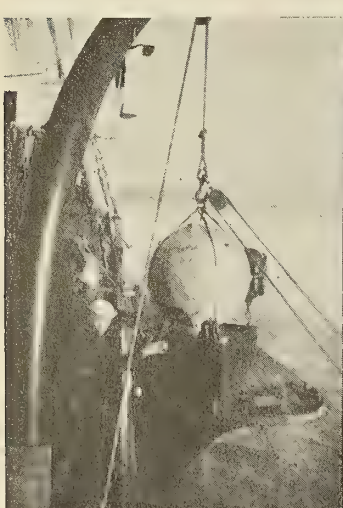


Fig. 5.—Swinging Mine Aboard

Fig. 6.—Hoisting Mine from Barge

Fig. 7.—Mine Leaving Tracks at Stern

Fig. 8.—Premature Explosion of of Mine Just Astern Ship

St. Louis Barge Terminal Under Construction

Revival of Mississippi River Traffic—III

Special Structural Features of Barge Terminal at St. Louis—Arrangements of Cargo-Handling Machinery—Terminal Costs

BY M. VON PAGENHARDT*

THE purpose of public river terminals may be summarized as follows:

1. To encourage the revival of river traffic by providing proper connections with the railroads.
2. To furnish warehouse space for boats and shippers.
3. To insure the lowest terminal cost.
4. To extend the benefits of the cheaper water rates.

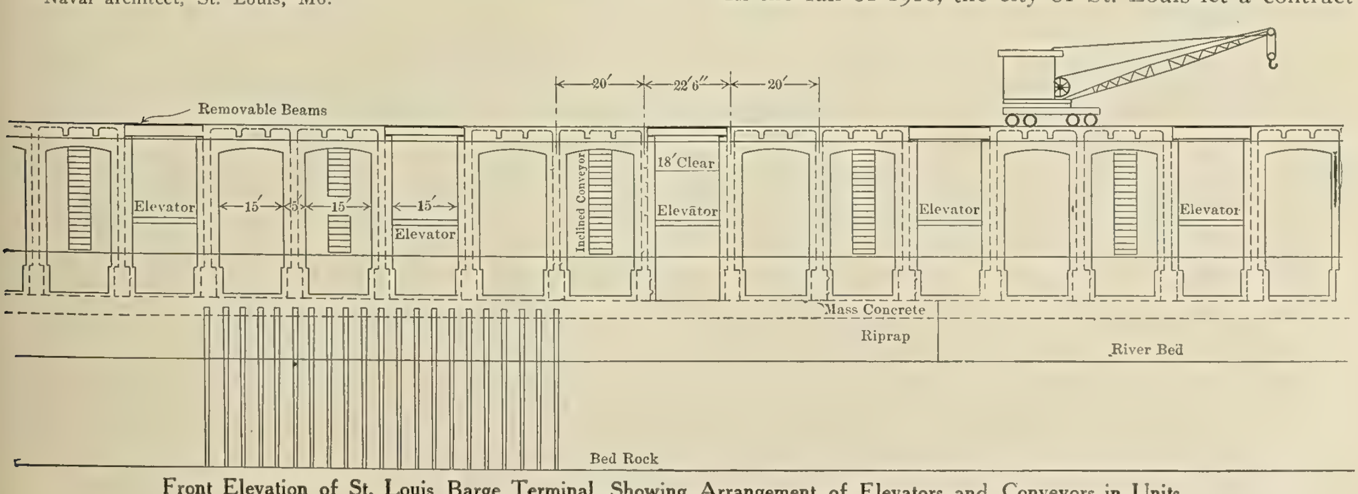
Economical public terminals are essential for short water hauls and of equal value for long water hauls, inasmuch as water-borne freight must bear the expense of loading and unloading.

The handling and terminal expense, whatever it may be, must come out of the water rate, and, as water rates are lower than rail rates, the water haul must be sufficiently long to save enough out of the transportation, maintenance and overhead costs to pay for this double handling. The lower the terminal costs, the less must be set aside for terminal handling and the shorter the distances over which the lower water rates can be applied. Although long water hauls can pay a higher terminal cost than short water hauls, any saving in terminal expense can be applied in lower water rates, thus increasing the effectiveness of the water route and bringing the town with economical river terminals nearer to the world market.

The recommendations of a committee of terminal engineers appointed at the Second Annual Conference of the Mississippi Valley Terminal League, held at St. Louis, February 15-16, 1916, contained outlines of designs for Mississippi River terminals, methods of freight handling, classification of terminals according to their yearly tonnage, and types of dock construction.

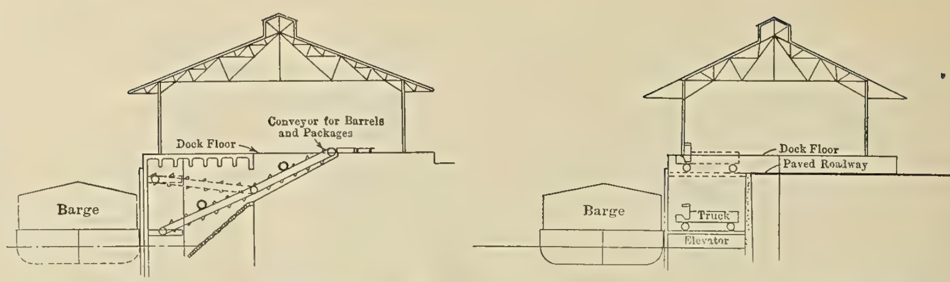
In the fall of 1916, the city of St. Louis let a contract

* Naval architect, St. Louis, Mo.



Front Elevation of St. Louis Barge Terminal, Showing Arrangement of Elevators and Conveyors in Units

for a public dock and terminal designed by the city's consulting engineer, C. E. Smith. The terminal was located on North Market street, where the city owns a long stretch of waterfront available for present construction and future extension, and at a point where the harbor line was sufficiently far out to provide adequate space for terminals. The location is not far from the business district and is reached by wide paved streets having easy grade. North Market street, for example, is 100 feet wide, with a maximum grade of 2 percent.



Cross Section, Showing Arrangement of Truck Elevator and Incline Conveyor, at St. Louis Terminal

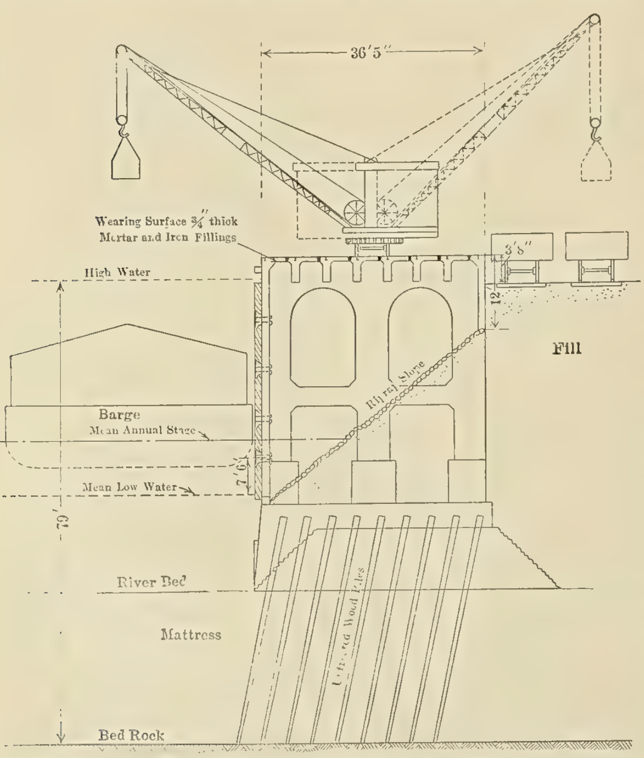
Design and Construction of the St. Louis River Terminal

The cross section shows one of the intermediate bents, there being seven of these in each unit, and two solid walls on either end of each unit adjacent to elevator openings, making each unit 160 feet long exclusive of the elevator. The front elevation shows a section of the completed terminal, 1,000 feet in length.

The location of the face of the wall, half way between the two harbor lines, placed it about 250 feet out in the river beyond the bank line, which position, in turn, necessitated the placing of 500,000 cubic yards of fill. The spring flood of 1917 deposited about 100,000 cubic yards of sand behind the construction, the high water of 1918 added 50,000 cubic yards more, and when the water receded the sand fill was within 30 inches of high water. With the river 23 feet on the gage, the total depth of fill in some points amounted to about 25 feet.

Pile Foundation

The pile foundation consisted of 220 rows of 9 piles each, 45 to 50 feet long. These were placed 4 feet apart in each direction and were driven in 35 to 40 feet by the use of a 2-inch jet pipe 50 feet long. In some cases the jet was so effective that the weight of the pile hammer forced the pile 40 feet into the jet hole without striking a blow.



Cross Section of St. Louis Barge Terminal, Showing Construction of Foundation and Installation of Cargo-Handling Machinery

To prevent the river from scouring under and washing away the pile, dikes, woven mattresses made of 1-inch boards, in all 80 feet wide and 1,000 feet long, were sunk on the river bed, parallel with the face of the dock and extending 10 feet under the face of the terminal and 70 feet out into the river beyond the structure.

The space around the pile heads, from the river bed up to 2 feet below zero, was next filled with riprap 8 to 10 feet deep, which was dropped among the pile heads from barges, leaving the pile heads projecting two feet above the top of the riprap.

Concrete Foundation

Temporary piles were then driven 10 feet apart along the face and the back of the structure, the tops of the piles extending to 12 feet above zero. Inside of these piles, plank bulkheads 4 feet high on the back and 14 feet high on the face of the structure were placed to hold the front and back edges of the concrete foundation slab. The pile heads extend into the concrete for a distance of 2 feet. This foundation slab, when finished, will consist of a solid slab of concrete 36 feet wide, 4½ feet deep and about 900 feet long, resting upon and held in place by about 2,000 foundation piles.

The concrete footings are raised above the foundation slab and are connected to it by reinforcing rods. Each of these footings is 4 feet wide, 6 feet long and 7 feet high, extending to the 9-foot level on the gage. Seven concrete bents were placed to each 160-foot unit. At intervals, solid panels were built into the bents and curtain walls were placed between these bents to form vertical shafts for elevator openings.

The concrete floor consists of slabs and T-beams of continuous construction, each unit consisting of eight spans, 20 feet each. The front beam was arched for appearance and added strength. The rear beam was built 12 feet deep to form a partial curtain wall with which to hold back the fill behind the terminal down to the level, from which it was permitted to slope under the structure. Six 80-pound rails were imbedded in the floor of the structure; the two outer rails, about 35 feet apart, were placed to support the overhead traveling cranes, the other four rails to form two tracks of standard gage on which railroad cars and revolving cranes may be placed. All rails are bonded together with copper bonds to carry electric current, if required.

Warehouses, Driveways and Tracks

A temporary frame warehouse has been placed behind the first unit, with a railroad track on the land side of the warehouse. Wagon delivery is made on the land side of the warehouse and at each end. Between the dock and

warehouse a space 24 feet width has been left open for two railroad tracks serving such freight as can be handled direct from boat to car and *vice versa.*

Cargo-Handling Machinery

The terminal is designed for vertical lift machines. Any number of locomotive cranes can be operated simultaneously with overhead traveling gantry cranes. Large truck elevators of 15-ton capacity are to be installed. These will be so arranged that motor trucks can drive from the street onto them and then be lowered to the water's edge. Additional vertical chain elevators for miscellaneous freight are under contemplation.

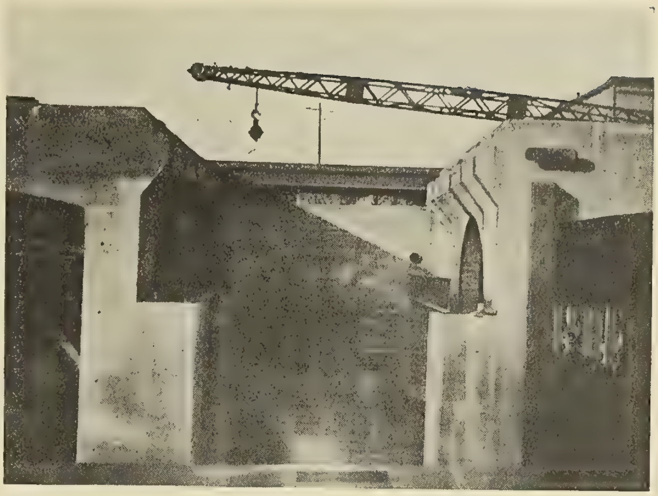
Cargo-Handling Capacity

The capacity of the St. Louis terminal development is entirely dependent on the machinery placed upon it. The ultimate track capacity of this design is for fifty-four cars for the first two dock units of 360 feet, or with only two switchings per day and an average load of 20 tons per car 2,160 tons could be loaded and unloaded per day, which would provide a track capacity equal to a dock capacity of 500,000 tons per year. With the completion of the six units as planned, one and a half million tons could be handled per year if sufficient handling machinery is placed upon the dock. It is expected to actually take care of from 150,000 to 180,000 tons per year by the use of the first two completed units in the coming year.

Terminal Costs

The terminal cost is being defrayed partly by public and partly by private funds. The public cost is the interest on bonds, sinking fund, maintenance, depreciation and insurance, which may be placed at 8 percent of the total investment. If $500,000 (£105,000) is required to build six docking units of a combined length of 1,000 feet, and 500,000 tons of freight are handled by these units, then a fixed charge of 8 cents (0/4) would have to be levied on each ton of freight handled. As a matter of fact, this charge, usually appearing as a wharfage charge, should be partially or wholly absorbed by the city in the interest of the general community.

The switching cost should be considered a semi-public expense, inasmuch as it is in the power of the city properly to protect the boat lines from excessive charges. The remainder of the handling expense—labor, electric power and water—should at a modern river terminal not exceed 20 cents (0/10) a ton for all classes of freight.



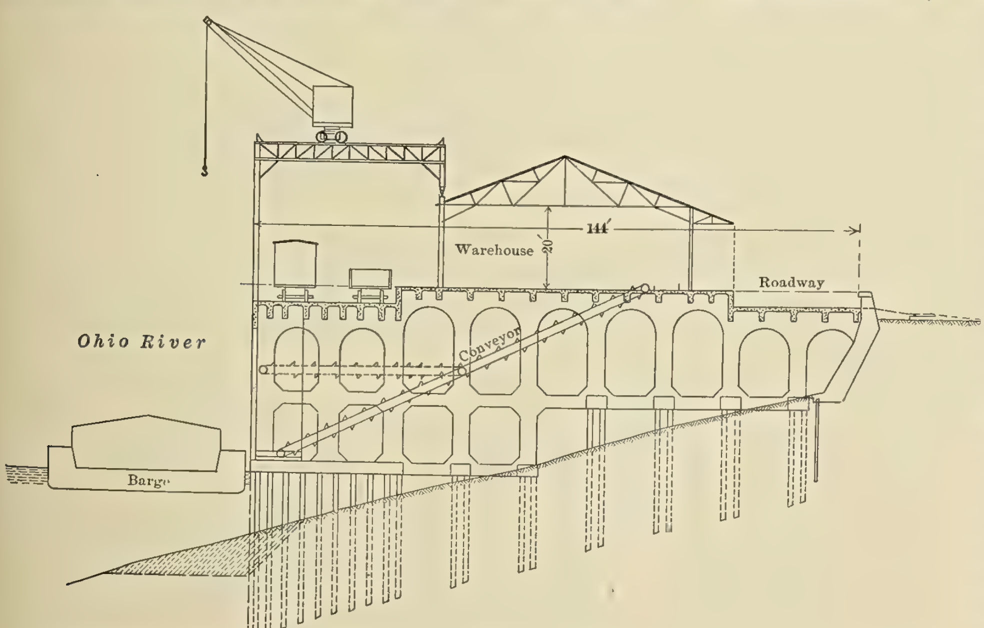
Completed Unit of St. Louis Terminal, Showing Construction Allowing the Removal of Beams

Conclusion

The river cities are beginning to see the necessity for building river terminals, but they are confronted by the difficulty of finding the necessary funds for an expenditure which is primarily public. While large cities like St. Louis or New Orleans can see their way clear to invest in any terminal enterprise justified by the prospective tonnage, smaller cities are not in the same position. On the other hand, since the waterways are now under Federal control and the Government has established barge service on the Mississippi River with an annual tonnage capacity of one million tons for the lower river and a half a million tons for the upper river, definite action must at once be taken in the matter of terminals, or the whole project of general freight traffic by river is doomed to failure.

The cities of Cairo, Helena, Memphis and LaSalle have taken some definite action in preparing plans and estimates for prospective terminals, but final action is everywhere postponed. It appears that the question of terminals cannot be left entirely to the initiative of smaller cities; since the project affects the whole district, and, in the last analysis, the whole country, it should be answered in a definite form by the Federal Government.

At all events, as Senator Reed very wisely said, coincident with the work of development of river terminals, the business interests should organize and arrange to furnish cargoes to the capacities of the boats available. This is the only way to get a fleet in the first place, and the only way to keep it. Without adequate terminals, river navigation will fail.



Cross Section of Proposed River Terminal of Reinforced Concrete for Cairo, Ill. Designed by C. E. Smith

Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Advantages of Having the Steamboat Inspection Service Represented in Foreign Countries

In this month's issue it is stated that efforts are being made to keep our consular service abreast of our merchant marine. The idea is good, but, to my mind, what is urgently needed is for our Steamboat Inspection Service to be represented in foreign countries.

It is true that no other nation is so represented, but that is no reason why we should not be. I have heard the thing discussed both pro and con since our merchant marine has started to expand, and can see many benefits to be derived from the plan. There is no doubt but that it would be of the greatest benefit to shipowners to have a credited mechanical representative of the United States Government right on the job when a ship needs repairs.

In many cases it would, I think, tend to keep the cost of repairs at as low a figure as possible, which in turn would save the time of the ship. It would also take a load of responsibility off the shoulders of the captain and chief engineer. In fact, the benefits of the plan are so numerous that it is a wonder that the plan has not been put into effect before this.

In any case, I would like to see the measure discussed, so let us hear from others either for or against it

New York. "One Hundred Percent."

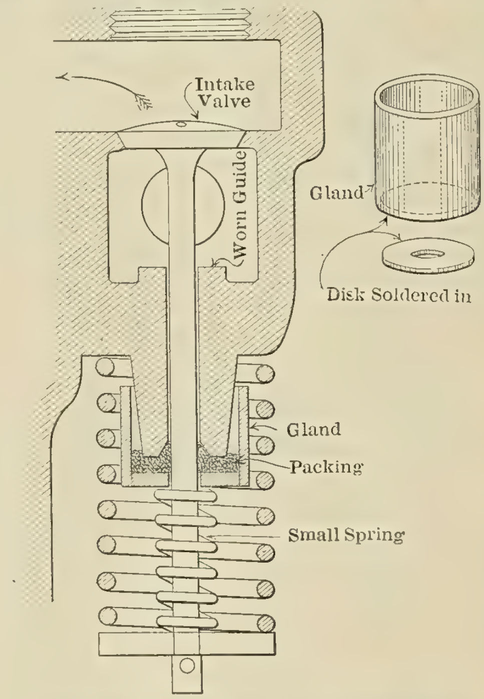
Curing Leaky Valve Guides

The gasoline (petrol) engine of the ship's motor sailer had been steadily losing power, and in spite of frequent examinations of the piston compression and adjustment of the carburetor mixture the trouble continued. Finally one day when the machinist mate was grinding in the intake and exhaust valve he noticed that the valve stems were a very loose fit in the guides, so loose, in fact, that they shook easily and daylight could be seen between the stem and guide. This excessive wear had been caused by long service; the steel stems running in just the plain cast iron guide, no bushings had been installed on this make of engine.

It was this space around the stems of the intake valves that caused the engine to lose power, for on each suction or intake stroke the pistons would pull in through these worn guides a considerable amount of air. This, of course, lessened the ability of the piston pulling in the proper mixture of gas from the carburetor, so that the engine was continually running on a weak mixture and could not develop power. The trouble was temporarily cured as shown in the sketch.

Pieces of brass tube with the disks soldered into the bottom were made to answer for packing glands. Each intake valve was removed, and the bottom of the cast iron guide holes was chamfered to make the packing fit snug to the stem. The valves were put back; the improvised packing glands with some soft packing were slipped on over the stems, and these held up against the bottom of the guides by special small springs that fit inside the regular valve spring. By reference to the sketch, the scheme will be quite clear.

This cured the trouble, and it was only necessary to renew the packing once in a month. One of these days



Improvised Valve Guide and Packing Gland

when the ship goes to sea for a long trip and the old motor sailer is in the skids, we will take the engine out, ream the guides and make bushings for them, which they should have had in the first place.

Machinist's Mate.

Point of Cut-Off

In the February issue, page 114 of the Questions and Answers column, I note in particular question and answer No. 993, relative to point of cut-off. The writer of the answer gives two interesting ways of determining the point of cut-off, and mentions the possibility of there being arbitrary rules in existence that may also be employed for such problems. Here follows a rule that is old, and gives results very close to the methods which appear in the paper. The formula is:

$$x = \left(\frac{2 \times \text{lap} + \text{lead}}{\text{travel of valve}}\right)^2 \times \text{stroke of piston.}$$

In which x = the number of inches of the stroke to be completed. All the dimensions are expressed in inches.

Applying the formula to the problem given in question No. 993, the statement of the question becomes:

$$x = \left(\frac{2 \times 2.5 + .125}{10}\right)^2 \times 42 = 10.03 \text{ inches.}$$

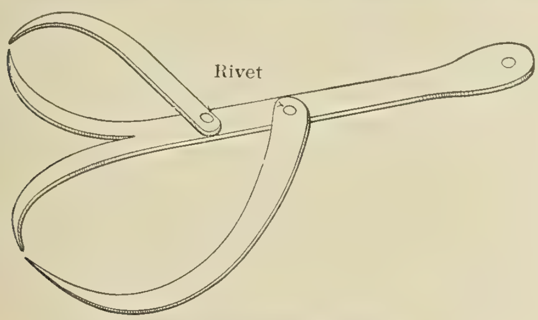
And, $42 - 10.03 = 31.97$ inches, point of cut-off from the *beginning* of the stroke. $\frac{31.97}{42} = .76$ of the stroke, which is at variance with the answer in the paper—.74—by only 2.6 percent, which is sufficiently close when it is considered that the angularity of the connecting rod would change both results.

Possibly some readers may find the foregoing useful in conjunction with the methods that have already been given.

Brooklyn, N. Y. Charles J. Mason.

Rough Calipers

Very handy rough calipers can quickly and easily be made from ⅛-inch plate stock, as shown in the sketch.

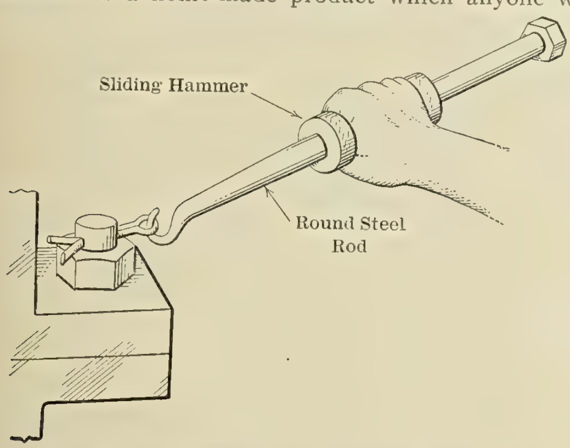


Handy Rough Shop Caliper

The main part is split and forged around to the curves. Two different length legs of suitable curves make it a handy double caliper. W.

Cotter Key Extractor

This tool is a home-made product which anyone with



Bar with Sliding Hammer for Extracting Cotter Keys

the spare time and material can very easily make. It is a tool that is very desirable to have, for I have found that it is quick and easy to use and also that it is a time and labor saver.

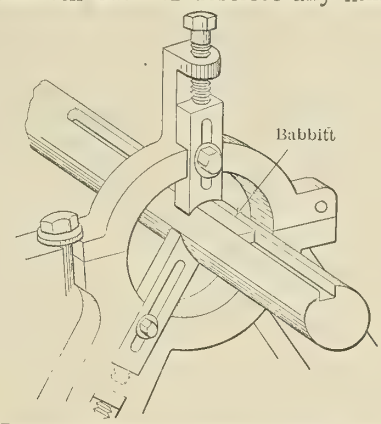
It is made in sizes to suit the user's need. The construction of it is so simple that when you have made one you will want to make another for the larger sizes. The rod is ⅜-inch diameter. One end is threaded for a short distance and a nut is riveted on, then a piece of round stock is drilled and slipped on the rod for a sliding hammer. Next, the end of the rod is tapered off and bent up into the hook, the correct shape being that shown.

The rod should be made of good machine steel, in order that it may be tempered. If it is desired to make it a workmanship-like job the sliding hammer can be turned up in the lath, so that it is a nice fit to the grip of the hand, and each end of it knurled.

Concord, N. H. C. H. Willey.

Steady Rest Kink

Once in a while one meets with a problem in lathe work that calls for some extra scheming to get around. It may be the setting up of a piece of work on the face plate, or the improving of special fixtures to make the lathe do milling or key seating. If the marine machinist aboard ship would sketch out and describe any kinks he invents



Device to Hold Key-Shaft in Steady Rest

to get around a job, I know that the rest of us would be sure to appreciate it and swap ideas.

The sketch shows a simple stunt that helped me. I had to turn a key-wayed shaft down, and it was necessary to hold the end of it in the steady rest. To do this so that the work would run smoothly was the problem. At first a strip of brass was wrapped around the shaft at the place where it was to turn in the steady rest, but this did not stop the vibration. Then the scheme of pounding in some Babbitt metal and scraping this true with the circumference was tried. This proved the right thing, and the shaft revolved as smoothly as could be desired.

Lathe Hand.

Worth Knowing

The cylinder heads, valve chest covers, caps of main bearings, etc., have special tapped holes for receiving eye bolts or lifting screws, as shown at *A* in Fig. 1, and generally when the time comes to use these threated holes they are chock full of dirt, and time must be spent digging and cleaning them out before the eye bolt or lifting set

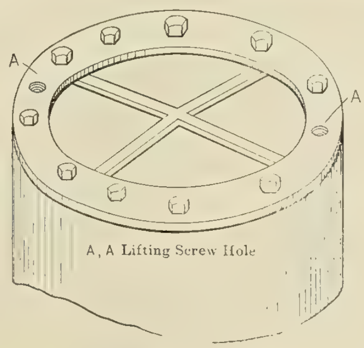


Fig. 1

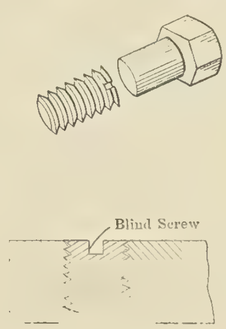


Fig. 2

screw can be put in. To eliminate this trouble, and as a means of preserving the threads of such holes on the machinery of our plant, we use blind screws to plug them when not in use, as shown in Fig. 2, the screws being made from old bolts. Always give the screws a generous coating of graphite grease when they are put in.

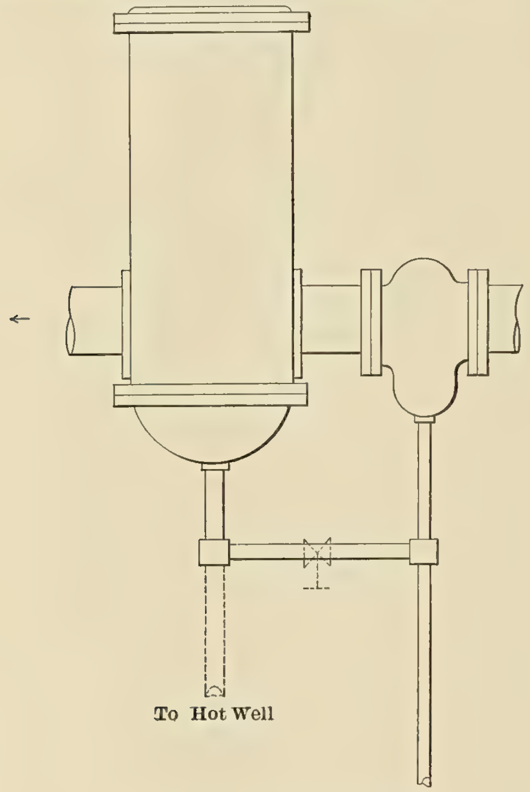
Engineer.

Revising Drainage of Heater and Separator

On taking charge of an ice plant, the writer found a closed heater, preceded by an oil separator, as shown in the sketch, and noticed that the drips from the separator and heater were carried to one trap and blown to waste. The drips from the separator, of course, could not be reclaimed, but the drips from the heater represented pure condensation because the oil was taken from the steam by the separator.

These drips from the closed heater represented a loss of pure water to the extent of 1,000 pounds per hour, and also represented a direct loss in heat, because they were at a temperature of about 190 degrees.

To remedy this condition, the connection from the separator to the trap was maintained, but a valve was put



Sketch of Drainage Connections

in the horizontal line leading from the heater drip, so that the latter could be cut off from the oily waste discharge. The pure returns, after the heater and piping were blown out to free them of any accumulation of oil, were piped to the hot well where the water went to make up a portion of the feed supply.

Philadelphia, Pa. W. A. Lailer.

How High Is a Vacuum?

The lack of a separate system of terminology for mechanical pressures is due, no doubt, to the self-suggesting analogies with altitude, which made the old altitude expressions readily understood in their new applications. It is really difficult to imagine anything more natural than that a large number of pounds pressure should be spoken of as "high," or that a relatively small number of pounds should be known as "low." It is only when we go below the datum level of atmospheric pressure that the analogies become less apparent, and we find ourselves groping among needless inconsistencies and foolish contradictions.

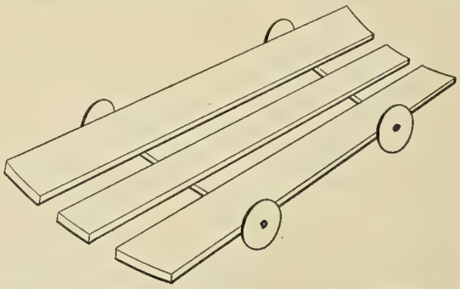
Take a homely example. A man whose property is 500 feet above sea level erects a flagstaff 80 feet high. The top of his flagstaff is 580 feet high, if he is speaking to a topographical engineer; and it is 80 feet high, if he is reeving off halyards. The steam engineer follows him exactly with 14.7 pounds per square inch corresponding to the 500 feet elevation, 200 pounds absolute corresponding to the 580 feet, and 185.3 pounds gage corresponding to the 80-foot flagstaff. But suppose the property owner digs an 80-foot well. The bottom of the well is 420 feet "high" above sea level; and it is also 80 feet "deep" when referred to the surface of the ground—being "high" or "low" according as it is viewed from sea level or from the locality. The steam engineer makes fairly good weather of it so long as he speaks of "one pound absolute pressure," but he gets hopelessly lost when he looks down 13.7 pounds below atmospheric pressure and calls it "28 inches vacuum." He is almost sure to call it a "high" vacuum, which might be permissible, if we could also speak of a "high" well. It is almost equally certain that he will speak of "amount" of vacuum, whereas a man who spoke of "amount" of well or "amount" of flagstaff would be tapped for the simples.

Since we have irrevocably adopted the altitude ideas of "high" and "low" for expressing the relative degrees of pressure, and, since it is unquestionably desirable to be consistent throughout the entire range, it is suggested that the term "deep vacuum" be used instead of "high vacuum," and that the term "depth of vacuum" be used instead of "height of vacuum," "amount of vacuum" and similar expressions.

Washington, D. C. Q. B. Newman.

Handy Device for Cleaning or Examining Boilers

In the inspection and cleaning of large boiler units it is sometimes a tiresome and awkward job to navigate from one end of the boiler to the other. To facilitate this work, some boiler inspectors use a small car designed somewhat along the lines of the sketch. This is made about 3 feet long and 18 inches wide, just large enough to support the torso of the body, leaving the hands and



Car Designed for Facilitating Inspection of Boilers

arms free to work and the legs available to propel the little truck. Wherever frequent boiler cleanings or inspections are made, or where large batteries of boilers are installed and the conditions permit, the use of such a carriage will be found materially to assist in the work of the boiler man.

Philadelphia, Pa. W. A. Lailer.

Remember that brass pipe "iron pipe size" does not come threaded, nor are couplings furnished. Heavy, extra heavy and hydraulic fittings are obtainable. In small fittings they should all screw up 4½ threads by hand.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

There will appear in this column from time to time questions which have been asked by the Board of Steamboat Inspectors in the various examinations for engineers' licenses conducted by them. Such questions will be denoted by an asterisk (*) placed before the number if from examination for grade of chief, and by a dagger (†) if from examination for other grades.

Pitch of Propeller

Q. (1001).—Please explain a method of obtaining pitch of a propeller. Also what is meant by the term "angle pitch"?

A. (1001).—The plumb bob method is often used and is described in many of the texts. The scheme described below is slightly more accurate and will give the pitch of the propeller of a single-screw vessel at several points of the blade with but little more trouble than is required for one point.

The plan is as follows: Clamp a batten near the aft edge of the rudder, so that a wooden straight edge, when placed horizontal, will bear upon the batten and on the rudder post. Locate a horizontal line by scratching lines *A* and *B* on the rudder post and on the batten. The propeller must now be turned so that the straight edge will

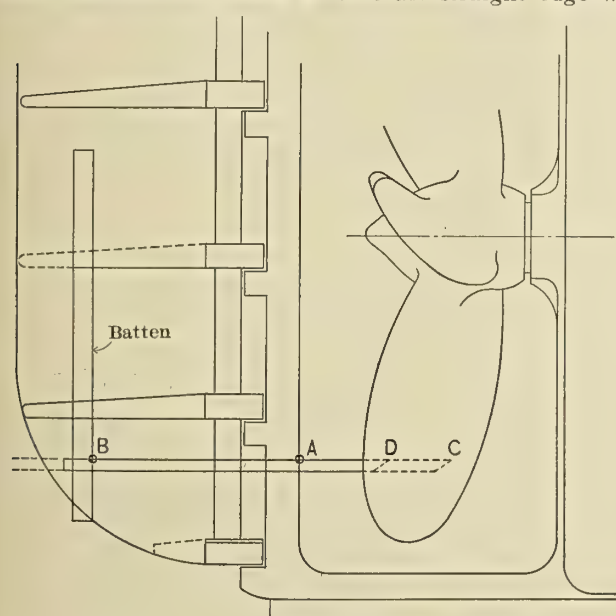


Fig 1

intersect the helical surface of the propeller blade not far from the leading edge. Mark on the propeller blade the point where the batten intersects same (as at *C* in the figure), also make a scratch on the straight edge opposite *A*. Now rotate the propeller until the straight edge intersects the propeller blade not far from the following edge of the blade and mark the point *D*, and another point on the straight edge opposite *A*. The difference between our two marks on the straight edge will be the portion of the pitch corresponding to the angle the blade has been turned through. It is clear that the following equation will hold true:

$$\frac{\text{Pitch}}{\text{Part of pitch}} = \frac{\text{Circumference}}{\text{Part of circumference}}, \text{ or}$$

$$\frac{P}{\Delta P} = \frac{2\pi R}{\sqrt{\overline{CD}^2 - \overline{\Delta P}^2}} \text{ (approximately).}$$

Where P = pitch.
ΔP = part of pitch (difference between marks made on straight edge opposite A).
R = distance between top of straight edge and center line of shaft.
CD = distance between points C and D measured on blade.

All distances to be measured in the same unit.

The pitch thus obtained will in most cases be sufficiently accurate for ordinary use. If the propeller has very wide blades, points *C* and *D* should not be taken too far apart, or the chord ($\sqrt{\overline{CD}^2 - \overline{\Delta P}^2}$) will differ appreciably from the arc.

This method can be conveniently used to obtain the pitch at several points on each blade, from which a fair average can be obtained.

The term "angle of pitch" is not often used, but is the angle which the helix at the blade tip makes with a plane

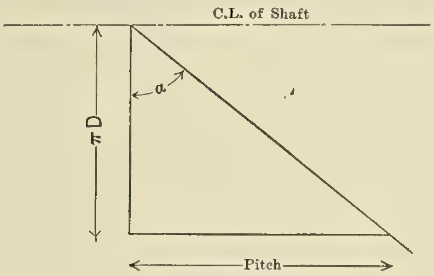


Fig. 2

perpendicular to the shaft axis or α in Fig. 2, which is easily laid out when we remember that the screw will advance a distance equal to the pitch in one revolution.

Development of Shell Plating

Q. (1002).—Will you kindly give me an approved method of developing shell plating on the mold loft floor. Is there a practical method of doing this without resorting to triangulation?

A. (1002).—Practice varies in the different yards as to how much of the shell should be developed in the mold loft. Many yards, however, are lifting only a few of the plates in ordinary cargo steamers.

Concerning the best method of developing shell plate, triangulation is the basis of most of the plans. A very good article on this subject by T. L. Cohee appeared in Marine Engineering, September, 1917.

Any twisted surface which has straight lines for its traces on a series of parallel planes can be developed; that is, laid out flat. A surface which has curvature both ways is undevelopable and by no direct process of geometry can the true shape or area be obtained.

Shipbuilding and General Marine News

**Contracts for New Ships—Shipyard Improvements—
Engineering Projects—Improved Appliances—Personal Items**

ROSSETER PRESENTS SHIPBUILDING PROGRAMME

Four Types of 9,800 Deadweight Tons and Upwards

J. A. Rosseter, Director of Operations of the Emergency Fleet Corporation, has presented a programme for future shipbuilding to the Pacific Coast shipbuilding industry. The following types of vessels are included:

Group 1. A three-deck, shelter-deck, single-screw steel freight steamer, 420 feet over all; 405 feet between perpendiculars; molded beam, 56 feet; molded depth to shelter deck, 30 feet 9 inches, with a carrying capacity of 10,000 tons deadweight, with a draft of 26 feet, equipped with balanced quadruple expansion engines of approximately 4,000 horsepower, and three oil-burning Scotch boilers, with steaming radius of 13,500 knots without bunkering.

Group 2. A three-deck, shelter-deck, single-screw freight steamer, 490 feet over all; 470 feet between perpendiculars; molded beam, 62 feet; molded depth to shelter deck, 43 feet, with carrying capacity 12,500 tons deadweight, with a draft of 29 feet 2 inches, equipped with balanced quadruple expansion engines of approximately 5,600 horsepower and five Scotch boilers, oil burning, with steaming radius of 14,000 knots without bunkering.

Group 3. A three-deck, shelter-deck, steel freight steamer, 522 feet over all; 500 feet between perpendiculars; molded beam, 68 feet; molded depth to shelter deck, 45 feet 6 inches, with carrying capacity 15,000 tons deadweight, and draft of 30 feet 8 inches.

These vessels will be equipped with either twin-screw balanced quadruple expansion engines of approximately 6,600 total horsepower, or single-screw balanced quadruple expansion engines of approximately 6,6co horsepower and six Scotch boilers, oil burners.

Group 4. A three-deck, shelter-deck, twin-screw motor freight vessel, 440 feet over all; 425 feet between perpendiculars; molded beam, 56 feet; molded depth, 38 feet to shelter deck, with carrying capacity 9,800 tons deadweight.

New Ship Contracts

The Prince Rupert Shipbuilding & Engineering Company, Prince Rupert, B. C., has received a contract to build two 8,100-ton steamships.

The Richardson Boat Company, North Tonawanda, N. Y., has a contract for building five 64-foot tugs for the War Department.

Director General Piez Resigns from the Shipping Board

Announcement was made on February 28 of the resignation of Charles Piez, director general of the Emergency Fleet Corporation, to take effect May 1. Mr. Piez, who is president of the Link-Belt Company, of Chicago and Philadelphia, will make his headquarters in Chicago.

Howard Coonley, vice-president in charge of administration, it is reported, will resign about the end of April to return to his duties as president of the Walworth Manufacturing Company, Boston.

$1,724,000 CONTRACT FOR SELF-PROPELLED BARGES LET

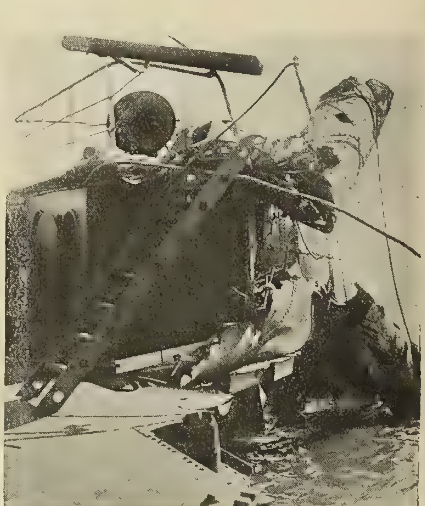
Three Companies Will Handle the Work—Deliveries by September First

The contract for building twenty self-propelled steel cargo barges has been let as follows: To the Terry & Trench Company, New York, 12, at $87,000 each; to the Dravo Contracting Company, Pittsburgh, Pa., 4, at $87,000 each; to Starr & Bennet, Newbern, N. C., 4, at $83,000 each. All barges are to be deliverd by September 1.

These self-propelled barges will be used with the twenty cargo barges, which are being constructed by the Terry & Trench Company, in units of three barges and one self-propelled barge, designed to carry from 5,000 to 6,000 tons. These units are conveniently handled in the Erie locks, which are 310 by 45 feet.

To recapitulate, the contract calls for 20 steam-driven steel cargo towboats; the length overall is 150 feet, breadth 20 feet, and depth 12 feet. Two compound engines supply the propelling machinery, with one oil-burning watertube boiler and auxiliaries, fuel tank and water tank. The engines are 14-inch stroke; 10-inch diameter high pressure, 24-inch low pressure.

Ward boilers are specified, or other approved makes passing the United States Government inspection, of 125 pounds per square inch working pressure, with 1,600 square feet heating surface.



Views Showing the Damages Received by the *Lord Dufferin* as She Was Towed Up the Harbor

ESTIMATED FINANCIAL STATEMENT OF THE SHIPPING BOARD

Cancellation Costs Given—Other Details Itemized

With the beginning of the year 1919, it is reported that funds available for the contract ship programme totaled $700,000,000. If the current expenditure amounts to $90,000,000 a month or over, only about $150,000,000 will remain on June 30 for future expenditure. Since it is reported from well informed sources that at least $111,000,000 will be needed to cover the claims for requisitioned ships, it is evident that not more than $39,000,000 can be utilized for future building.

A financial statement of the Emergency Fleet Corporation up to February 4, as given out by one of the leading shipbuilding corporations to the New York *Journal of Commerce and Commercial Bulletin*, is summarized below:

Total authorized expenditure...		$2,884,000,000
Less amount set aside for plant, property, docks, marine railways, etc....................		114,662,500
Balance for ship construction proper..............		$2,769,337,500
Total commitm'ts to Dec. 31, 1918.	$2,865,367,841	
Commitm'ts cancelled to Feb. 4, 1919.......	361,404,312	
Net programme Feb. 4, 1919.	$2,503,963,529	
Cost of Cancellations	92,869,088	
Cost of machinery cancellations ..	20,000,000	
Cost of shipyard extensions	13,860,000	
Total	$2,630,692,617	
Administrative expense	35,000,000	
Total		$2,665,692,617
Balance of authorization...		103,644,883
Of the amount above authorized for contract construction, viz..		$2,769,337,500
There has been so far appropriated		1,823,788,500
Balance for which appropriation is required.........		$945,549,500
Deduct		103,644,883
Leaves amount required to complete the contract programme.		$841,904,117
Of this there is needed to June 30, 1920....................		$549,653,254

Halt Building of Battle Cruisers

Secretary of the Navy, Josephus Daniels, has ordered the suspension of work on the six 35-knot battle cruisers already authorized until a decision as to the future type of capital ship has been made.

Because of the difference of opinion among naval experts, the large amount of money involved (between $180,000,000 and $200,000,000), and the great question of fighting efficiency at stake, the Secretary of the Navy has directed temporary suspension of the construction of these vessels.

The United States Navy Yard at Bremerton, Ore., is building two ammunition ships and seven seagoing tugs for the Navy Department. The yard has also entered bids for the building of five auxiliary naval cruisers to cost about $3,000,000 each. Awards have not yet been announced.

Damages for the Lord Dufferin

Three libels claiming $1,650,000 have been filed against the Cunard Steamship Company in connection with the sinking of the freighter *Lord Dufferin,* which was rammed by the *Aquitania* on February 28.

The wrecking derricks of the Merritt & Chapman Derrick & Wrecking Company, 17 Battery Place, New York, were on the scene one hour and a half after the collision occurred, and were able to manage the handling of the ship so that 4,000 bags of sugar in the bow of the vessel were kept entirely dry. The damages include complete destruction of about forty feet of the stern and the breaking of the propeller and propeller shaft.

FOREIGN CONCERNS WISH TO PURCHASE SHIPS

Passenger Steamships, Towboats and Tanker Wanted

A correspondent in France writes to Marine Engineering as follows:

"If you know of a good passenger and freight mail steamship for sale, please secure full information, prices, etc., for me."

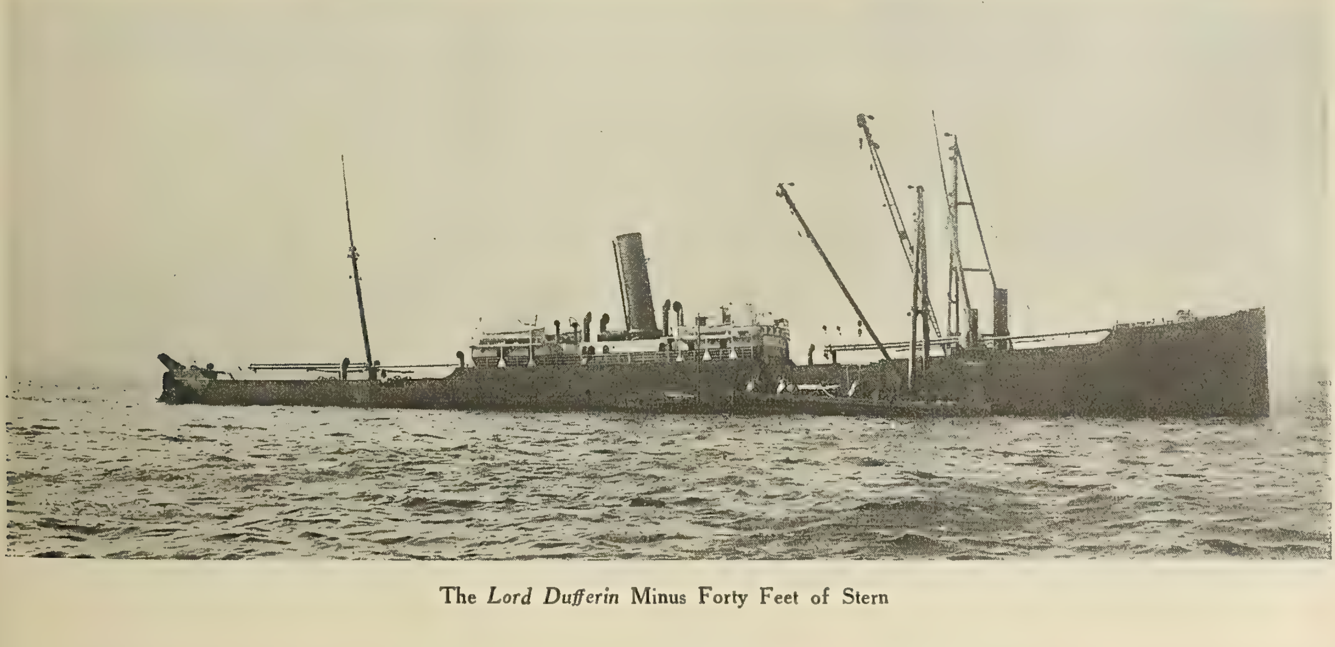
Our correspondent is in the market for towboats 600 to 800 horsepower. He requires full information as well as prices.

A correspondent in France writes to Marine Engineering that he is in the market for a passenger steamer for day service (paddle-wheel preferred), the vessel to be about 150 feet long and 5- to 6-foot draft.

Another correspondent in Europe, who manages an oil company, informs us that his company is looking for a steamer of about 1,600 tons deadweight, to carry, among other things, about a thousand tons of oil in bulk.

A correspondent in France writes to Marine Engineering, stating that he is in the market for several small steamers under 4,500 tons deadweight. Letters containing particulars regarding such vessels should give full information as to tonnage, carrying capacity, propelling machinery, type of vessel, lowest possible price and other details needed by a possible purchaser. Address Neuilly, care Marine Engineering.

Rene E. Bossiere, 4 Place Jules Ferry, Havre, France, writes to Marine Engineering that he wishes to get into correspondence with American concerns who wish to have agencies in France. He refers especially to manufacturers of shipbuilding materials, plates, shapes, forgings, anchors, chains—indeed almost anything and everything that goes into the construction of a vessel.



The *Lord Dufferin* Minus Forty Feet of Stern

RETURN SHIPYARDS TO PRIVATE CONTROL

Philadelphia to Have Municipal Drydock

Announcement was made by Howard W. Coonley, vice-president of the Emergency Fleet Corporation, that the yards of the Newport News Shipbuilding & Dry Dock Company, the Baltimore Dry Docks & Shipbuilding Company, the Sun Shipbuilding Corporation, and the Chester Shipbuilding Company would be turned over to private control by April 15.

Mr. Coonley has also been reported as promising the construction of three additional drydocks in Philadelphia under the supervision of the Emergency Fleet Corporation, if the city government does not find it advisable to begin construction with city funds.

Causes of the Accoma Disaster

A report issued by the Foundation Company, 233 Broadway, New York, builders of the wooden vessel *Accoma,* which was abandoned at sea after a hurricane on February 11, shows that the leaking of the vessel was due to a complication of causes.

Capt. Phillips testified that before undertaking the trip he had recommended that a steel rudder replace the wooden rudder, since he had experienced the stripping of the steering engine pinion on a previous voyage, due to the rigid construction. When the vessel was in the teeth of the storm the rudder snapped.

The engineer, A. C. Kick, reported that leakage in the port coal bunker, due to damage of the ash ejector, had made it impossible for the bilge and circulator pumps to eliminate the water as fast as it rushed in. He reported also that the contents of the fresh water tank had leaked out, due to inadequate repairs at port, which left the vessel with unequal ballast, so that added to her heavy overloading she was very seriously handicapped for this reason. The propelling machinery, he reported, functioned properly until the water prevented the raising of steam, which in turn made the abandonment of the ship necessary when the bilge pumps were no longer adequate. He mentioned that the leakage at the seams was probably less than might have been expected from the battering of such a heavy sea.

The Heavily Loaded *Accoma* Moored at New York Pier Before Sailing

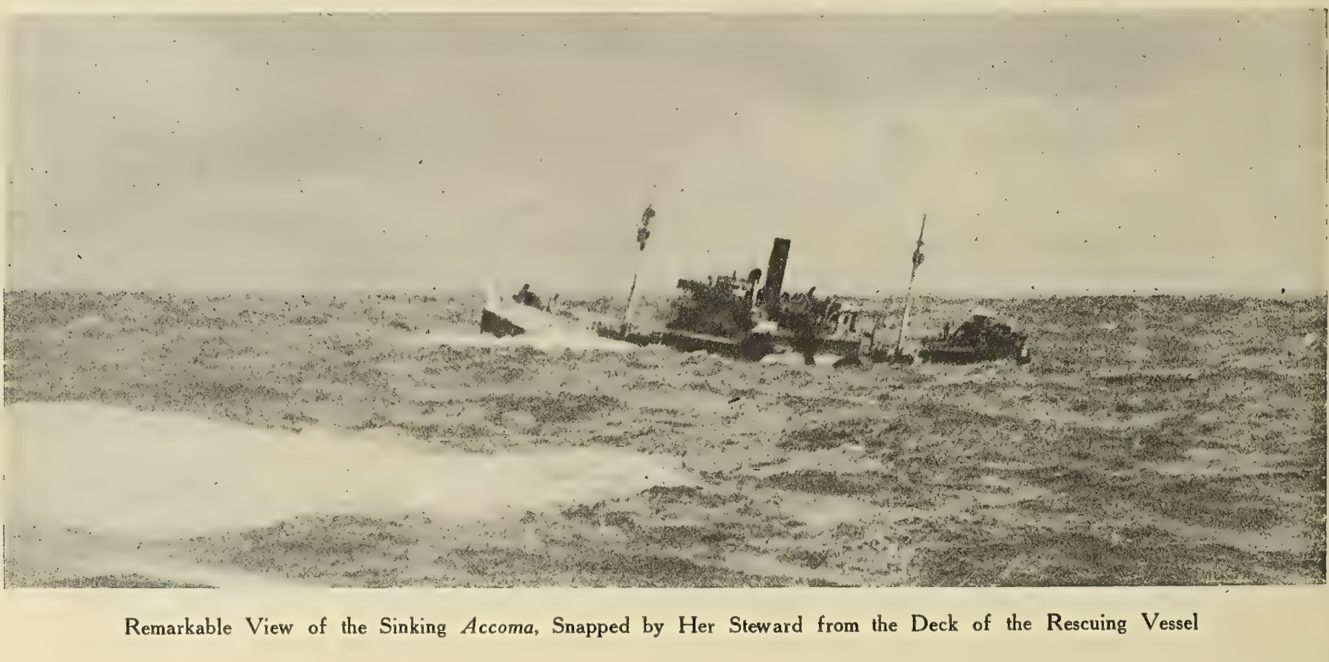
SHIPYARDS STILL PROHIBITED FROM ACCEPTING FOREIGN SHIP CONTRACTS

British Yards Now Opened

Almost daily, progressive shipbuilding concerns are receiving opportunities to build ships for foreign register. Each order or bid which they have to turn down should be a further argument in convincing the Government authorities of the wisdom of opening the yards at this time. We understand that many British yards are filling their books with all the orders they can handle, and are giving guarantees that work will be begun upon the new contracts within eight months, and that ships will be completed within sixteen months. American shipyards deserve the same opportunity.

Col. Wilson has announced that the British Government, after due consideration, has decided not to retain any shipyards for Government undertakings, provided they can be disposed of at fair terms.

The Shipping Board has now opened bids for 428,000,000 gallons of oil to be used on the oil-burning ships operated by the Shipping Board.



Remarkable View of the Sinking *Accoma*, Snapped by Her Steward from the Deck of the Rescuing Vessel

Fulflo Scientific Cooling for Marine Engines

Three difficulties have been encountered in adopting the centrifugal pump to the pumping of water for cooling marine engines and to the pumping of bilge water: Difficulty (1) in developing a suction great enough to permit of the use of a centrifugal pump above the level of the liquid being pumped; (2) in devising a centrifugal pump of sufficient diameter of impeller to pump the maximum amount of water required at minimum speeds, and to provide for the installation of such a pump in the small space generally available for that pur-

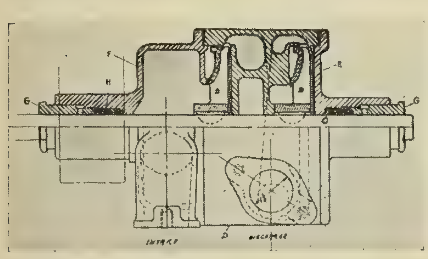


Fig. 1.—Design of the Fulflo Pump of the Duplex Type

pose; (3) in designing a pump which would deliver a sufficient volume of liquid at the minimum speed and yet not supply too great an amount at maximum speed so that the engine be kept too cool for proper and economical operation.

These conditions are met, it is claimed, by the combination of the Fulflo twin (duplex) pump and the Flocontrol manufactured by the Fulflo Pump Company, Blanchester, Ohio. This pump, which can be supplied in varying sizes to be used in connection with engines of from 50 to 300 horsepower, retains its prime under all conditions by the use of a priming chamber of the design shown at *F*, Fig. 1, and by the location of both intake and discharge at the top of the pump. When the pump is stopped, the water remaining in the discharge pipe flows back into the pump while the excess overflows through the intake. The priming chamber and pump body, however, retain a supply of water sufficient to create the necessary suction when the pump is again started. Where it is desirable to drain the pump to prevent freezing a drain valve is provided.

With 1¼-inch intake and discharge, this type of pump has a 30-inch suction, with a discharge of 20 gallons per minute at 1,200 revolutions per minute, and a 36-inch suction and a discharge of 40 gallons per minute at 1,800 revolutions per minute.

The Flocontrol, mentioned above, is the name given to the mechanism designed by the same company to control the flow of the Fulflo or any other pump where the capacity of the maximum or minimum speeds is greater or less than may be desired under varying conditions. This attachment can be furnished in various sizes with flanges for connection with pump or intake pipe or with flanges on one end and the other end arranged for brazing.

This apparatus may also be used with the Fulflo centrifugal bilge pump, a modification of the duplex type illustrated, which has but a single impeller. This pump can also be furnished in various sizes to meet specific conditions. When ⅜-inch piping is used, this pump has a capacity of 3 gallons per minute at 1,200 revolutions per minute and a suction lift of 30 inches, with a capacity of 5 gallons per minute and a suction lift of 36 inches at 1,800 revolutions per minute. If ½-inch piping is used, a discharge of 5 gallons per minute is obtained at 1,200 revolutions per minute with a suction lift of 30 inches, and a discharge of 8 to 10 gallons per minute at 1,800 revolutions per minute with a suction lift of 36 inches. No valves are used.

New Apparatus for Removing Thin Rust from Ships' Sides

The rotary scraper machine, designed by the Rotary Scraper Company, Inc., 17 Battery Place, New York, for removing rust and paint from iron and metallic surfaces, has been used to advantage by the Submarine Boat Corporation, Newark, N. J., and the Downey Shipbuilding Corporation, Staten Island, N. Y., for removing thin rust from the ship's sides before painting. A specially constructed spiral brush has been developed for this purpose.

The Division of Operations of the United States Shipping Board has tried out the new machine on the vessels *Nansemond* and *Otsego*. On the former 900 square feet of bulkheads, angle bars and other parts in the bunkers were scaled in thirty-two hours and fifty-five minutes, with two men working the machine. A surface of two square feet was chipped by the machine in sixty-six seconds, whereas hand scraping and chipping of a like area consumed eight

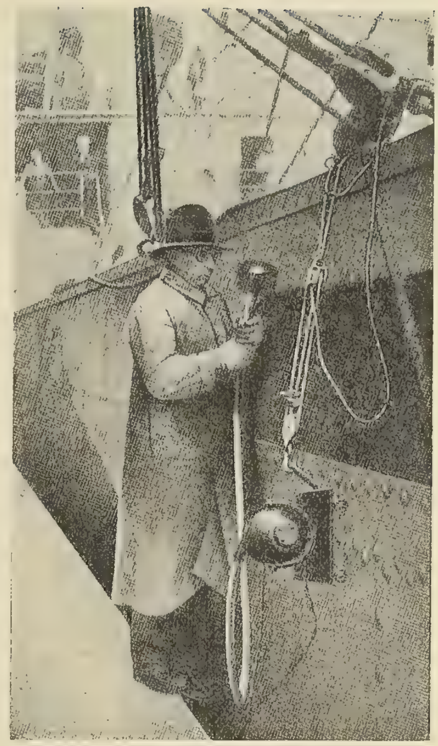


Fig. 1.—Using the Spiral Brush of the Rotary Scraper Company

minutes. The machine averaged 27.35 square feet of surface chipped per hour. On the *Otsego,* with two men operating the machine in the bunkers, it cleaned 1,500 square feet of angle bars, bulkheads and other parts in thirty-two hours. The better showing on the second vessel was probably due to the fact that the men had become more familiar with the use of the machine, and in consequence were able to do better, faster work. Reports on both jobs show that the work was excellently done.

Besides this special spiral brush the tools shown in the accompanying illustration are regularly supplied with the

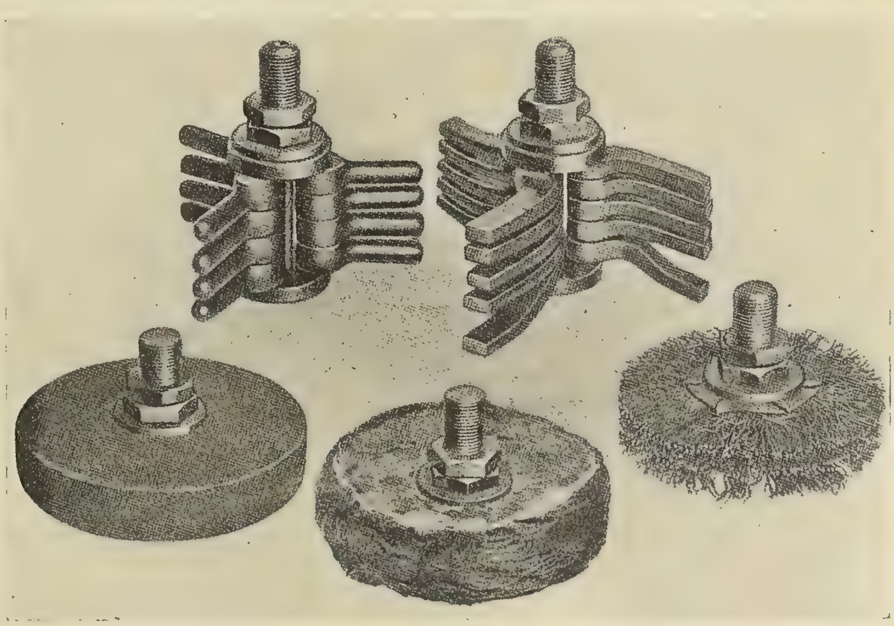


Fig. 2.—Hammers, Emery Wheels and Brushes Used on the Rotary Scraper

apparatus for various types of work. The complete set of tools consists of three hammer tools, round and sharp, one steel wire brush, one emery wheel and one buffing wheel. These parts are screwed into the handle piece spindle and held by a simple lock nut.

The flexible shaft through which power is supplied consists of an inner core of flexible wire, a flexible casing and a tool holder. The durable construction of the parts makes it possible to run the shaft at a speed of about 4,000 revolutions per minute without overheating. Since the core is provided with identical ferrules at either end, to connect it with the motor shaft and the revolving tool spindle of the hand piece, it can be reversed, which feature adds to the life of the apparatus.

The machine has been used to advantage for scaling boilers, and for grinding, drilling and reaming in foundry and machine shops.

Navy Department Uses Electric Tachometers

During the war electric tachometers, made by the Electric Tachometer Corporation, 435 North Broad street, Philadelphia, Pa., were installed on approximately 120 torpedo boats, destroyers and numerous vessels of other types, such as submarine boats, submarine chasers, scout cruisers, battleships, transports and fuel ships. Practically all ships coming under the jurisdiction of the Navy Department were fitted with electric tachometers; much of this installation work was handled by the Electric Tachometer Corporation.

By the use of tachometers in the engine room and on the bridge, it was possible for the bridge officers to have before them a constant indication of the revolutions of the engine and the consequent speed of the vessel. This knowledge was especially important when vessels were crossing the ocean in convoy formation, in order to insure the maintenance of the prescribed distance between the various units.

This company has lately constructed a new type of electric tachometer which is used on vessels having four propeller shafts. The new design, instead of indicating the speed of the shafts individually, indicates the average speed of the two port shafts and of the two starboard shafts separately. The new apparatus eliminates the expense and extra weight of the differential gearing, since the averaging is done electrically with greater accuracy.

The Fire Gun

A new type of hand fire-fighting device is shown in the "Fire Gun" made by the Fire Gun Manufacturing Company, Inc., 115 Fourth avenue, New York.

A stream of especially prepared chemical solution is forced out by a double-acting liquid pump for a distance of 30 to 40 feet. It is claimed that the apparatus is fool-proof. The composition of the fluid is such that it is a non-conductor of electricity. It will not freeze at 50 degrees below zero, and will not damage machinery. When the stream strikes the heat a solid blanket of non-combustible gas crowds out the air and puts out the fire.

Fig. 1.—Fire Gun

The gun is made in two sizes. The lighter gun weighs 7¾ pounds and holds 1¼ quarts of fluid. The heaviest gun weighs 11 pounds and holds 1¾ quarts of fluid. Separate containers are furnished to hold the liquid for recharging.

One of the fire guns is shown in the illustration.

New Application of Arc Welding

United States letters patent were issued to the Marine Decking & Supply Company, Philadelphia, Pa., on January 28, 1919, for an improved deck construction to be used in connection with the application of cementitious, asphaltic or other deck covering compositions. Originally it was the practice to rough up the steel so that an effective bond would be produced. Later this company instituted a method of fastening clips to the plates by means of tap screws. Under the patent now issued the company is able to accomplish the same results by the use of arc welding, which eliminates the possibility of leakage into the compartments immediately below. The new method is also more rapid.

Pangborn Equipment for Sand Blasting

Sand blasting, as applied to shipyard work, plates and hulls, with the "Pangborn" equipment, is a most effective cleaning method. The hose type machine is particularly adapted to the large work of the shipyard, as the abrasive,

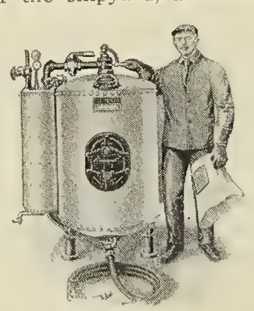


Fig. 1.—Pangborn Hose Type of Machine for Sand-blasting

always under pressure in the sand-blast chamber, is discharged in combination with the air at gage pressure, thereby obtaining the highest possible velocity. The machine handles all types of abrasive, either sand or metal. The kind of abrasive should be selected with a view to best economy to the work in hand.

The metal abrasives have many times the life of sand and create less dust, but their high first cost demands an adequate method of reclaiming. For the cleaning of metals to be galvanized or plated, sand is preferable, as experience has shown that the metal abrasives leave particles of fine metallic dust on the pieces, which prevent perfect coating. For general cleaning work, either type of abrasive will be found satisfactory and efficient. Sea sand and silica sands, by their hardness and sharpness, show best economy.

For the cleaning of ship hardware fittings or small parts, an automatic machine of the barrel or rotary table type is best adapted. These machines are

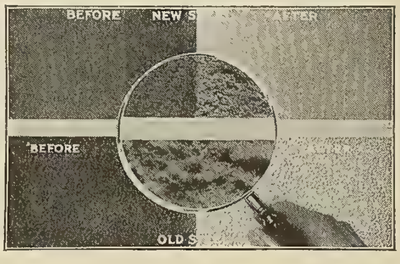


Fig. 2.—Magnified Section of Steel Plate Before and After Cleaning with a Sand-blast

made in the continuous operating type of gravity or suction feed, the abrasive being fed to the nozzle, either by gravity or by suction, and discharged in combination with the air. In all types of the apparatus, air pressure and grade of abrasive may be regulated to suit the demands of the material upon which the abrasive is being applied.

The sand blast, in its various types, is equally adaptable to the cleaning of castings, forgings, stampings, sheet, plate and structural shapes.

Bryant Unbreakable Interconnecting Blocks

The Bryant Electric Company, Bridgeport, Conn., has placed upon the market interconnecting blocks which are made of unbreakable composition. These blocks provide a means of making con-


Fig. 1

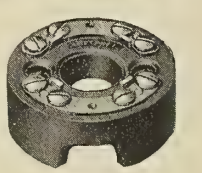


Fig. 2

nections for branch circuits in junction boxes without the labor and difficulty of making soldered connections, taps and tap-offs. The terminal plate binding screws are long, heavy and "staked," so that they cannot be dropped out and lost. The center hole provides for wire entrance from the back of the box if necessary.

Fig. 1 shows a block with a diameter of 1¾ inches and a height of 1 inch. The larger size, shown in Fig. 2, has a diameter of 1¼ inches and a maximum height of 1 inch.

The cartridge fuse base shown in Fig.

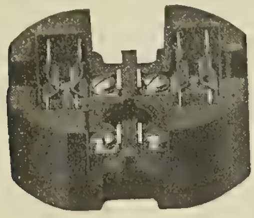


Fig. 3

3, which is also made of unbreakable composition, provides the means of fusing a circuit in a regular 4-inch junction box. As will be noted, there is ample room between the fuses for additional circuits to pass through the box. National Electrical Code standard cartridge fuses are used in this block.

Shipyards Contribute Grand Stand

The Todd Shipbuilding Corporation, New York City, financed the building of a large grandstand for the use of wounded soldiers in witnessing the parade which was held in New York City and Brooklyn on March 24 and 25. The men from the Tebo & Robins drydocks contributed their services for the building of the stand.

Wooden Ships Will Bring Railroad Ties East

It has been reported that Portland interests are about to close the charter of five wooden steamers for the purpose of carrying railroad ties to the East. The Railroad Administration is in the market for 100,000,000 feet. The shipping firm of Sudden & Christensen is said to have contracted to carry 7,500,000 feet of the shipment. Should all of the orders for tie material be placed with Washington and Oregon mills it is estimated that fifty or sixty cargo ships will be necessary to bring the shipment to the Atlantic coast.

Mississippi Barge Service Rapidly Developing

The largest cargo of packet freight that has been handled since the opening of the Mississippi-Warrior Waterways service on September 28, 1918, left St. Louis on March 7 by the towboat *Barrett*. The first up-stream capacity cargo is now en route from New Orleans to St. Louis. A. W. Mackie, manager of the Mississippi section of the Mississippi-Warrior Waterways, has reported that service will be operated at full capacity, both up and down stream, if shippers continue to increase their consignments in the next sixty days as they have in the last two-week period. The down-stream cargo consists of 892 tons of package freight; the up-stream cargo consists of 1,250 tons in four barges, towed by the towboat *Choctaw*.

Recent Launchings

Date of Launch	Name of Vessel	Tonnage	Type	Builder	Owner
Feb. 20	W-1	...	Concrete Boat	Great Northern Concrete Shipbuilding Company, Vancouver, B. C.	U. S. Government
Feb. 20	Gustan Hall	9400	Cargo	Virginia Shipbuilding Corporation, Alexandria, Va.	Emergency Fleet Corporation
Feb. 21	Champlaine	1500	Wooden Vessel	Vancouver, B. C.	French Government
Feb. 22	Worcester	....	Cargo Vessel	Groton Iron Works, Groton, Conn.	Emergency Fleet Corporation
Feb. 25	Obak	3500	Composite Vessel	Mobile Shipbuilding Co., Moshico, Ala.	Emergency Fleet Corporation
Feb. 27	Coaxet	9500	Steel Ship	G. M. Standifer Construction Corporation, Vancouver, Wash.	Emergency Fleet Corporation
Feb. 27	Sanpa	3500	Ferris Wood	Housatonic Shipbuilding Co., Stratford, Conn.	Emergency Fleet Corporation
Feb. 27	Gulf Queen	9500	Oil Tanker	Pusey & Jones Co., Gloucester, N. J.	Gulf Refining Co.
Feb. 28	Sangamon	7500	Cargo	American International Shipbuilding, Hog Island, Pa.	U. S. Navy Corporation
Feb. 28	Ingram	...	Destroyer	Bethlehem Shipbuilding Corporation, Fore River, Mass.	United States Navy
Feb. 28	West Cherow	8800	Steel Cargo	Northwest Steel Company, Portland, Me.	Emergency Fleet Corporation
Mar. 2	Wisconsin Bridge	....		Submarine Boat Co., Newark, N. J.	Wisconsin Bridge Co. of Milwaukee
Mar. 2	Milwaukee Bridge	....		Submarine Boat Corp., Newark, N. J.	Milwaukee Bridge Co. of Milwaukee
Mar. 3	23-23	...	Barge	Machias Ship Construction Co., Machias, Maine	Emergency Fleet Corporation
Mar. 3	W-2	....	Concrete Vessel	Great Northern Concrete Shipbuilding Company, Vancouver, B. C.	United States Government
Mar. 3	Aspenhill	3500	Ferris	Coast Shipbuilding Co., Portland, Ore.	Emergency Fleet Corporation
Mar. 4	Unnamed	....	Concrete Car Float	Liberty Shipbuilding & Transportation Co., Cleveland, O.	U. S. Army
Mar. 5	Abilla	3500	Ferris Vessel	Grant Smith-Porter Ship Company, Aberdeen, Wash.	Emergency Fleet Corporation
Mar. 6	Alector	3500	Wooden Vessel	Grant Smith-Porter Ship Company, Aberdeen, Wash.	Emergency Fleet Corporation
Mar. 7	Joseph J. Hock	2000	Barge	Arundel Shipbldg. Co., Fairfield, Md.	Eastern Transportation Company, Baltimore, Md.
Mar. 8	Guardsman	....	Tug Boat	M. M. Davis and Son, Inc., Solomons, Md.	Emergency Fleet Corporation
Mar. 8	R-6	....	Submarine	Fore River Shipbuilding Corporation, Quincey, Mass.	United States Navy
	Unnamed (3)	...	Barges	Murnan Shipbuilding Corporation, Mobile, Ala.	United States Railroad Administration
	Cretefarm	1000	Ferro-Concrete	Warrenpoint, Lough Foyle, Ireland	British Ministry of Shipping
	Mason	....	Destroyer	Newport News Shipbuilding and Dry Dock Company, Newport News, Va.	U. S. Navy
	Briarcliffe	3500	Ferris Wooden Steamer	Russell Shipbuilding Company, Portland, Me.	Emergency Fleet Corporation
	Jennie Flood Kreger	1614	Schooner	Mathews Brothers, Belfast, Me.	Crowell & Thurlow, Boston, and others
	Charles A. Dean	1175	Schooner	R. L. Bean, Camden, Me.	Merchants Marine Company, Boston
	Hull No. 966	....	Steel Ship	Pensacola Shipbuilding Co., Pensacola, Fla.	Emergency Fleet Corporation
	Marguerite Emyss	....	Schooner	Boothbay Harbor, Me.	
	Unnamed	....	Wooden Barge	Murnan Shipbuilding Co., Mobile, Ala.	U. S. Railroad Administration
	City of Pascagoula	....	Wooden Ship	International Shipbuilding Co., Pascagoula, Fla.	Emergency Fleet Corporation
	Hull No. 484	....	Barge	Interlake Engineering Co., Cleveland, O.	U. S. Navy
	S-34	800	Submarine	Bethlehem Shipbuilding Corporation, Wilmington, Del.	U. S. Navy
Mar. 9	Dochet	7800	Steel Steamer	Downey Shipbuilding Corporation, Staten Island, N. Y.	Emergency Fleet Corporation
Mar. 9	McKeesport	9600	Steel Steamer	Federal Shipbuilding Co., Kearny, N. J.	Emergency Fleet Corporation
Mar. 11	Derbyline	12000	Steel Tanker	Bethlehem Shipbuilding Corp., Oakland, Cal.	Emergency Fleet Corporation
Mar. 11	Belisle	5500	Freighter	Hanlon Dry Dock & Shipbuilding Co., Oakland, Cal.	Emergency Fleet Corporation
Mar. 13	Comafran 1	1000	Concrete Ship	France	French Government
Mar. 14	Palafox	700	Barge	Palafox Shipbuildnig Co., Pensacola, Fla.	
Mar. 15	Cushnoc	9000	Steel Steamer	Pensacola Shipbuilding Co., Pensacola, Fla.	Emergency Fleet Corporation
Mar. 15	West Munham	8800	Steamer	Columbia River Shipbuilding Corporation, Portland, Oregon	Portland Oriental Line
Mar. 15	Schenectady	7500	Cargo Vessel	American International Shipbuilding Corporation, Hog Island, Pa.	Emergency Fleet Corporation
Mar. 15	West Aleta	8800	Steamer	Schaw-Batcher Shipbuilding Co., South San Francisco, Cal.	
Mar. 15	West Kasson	8800	Steel Freighters	Long Beach Shipbuilding Co., Long Beach, Cal.	Emergency Fleet Corporation
Mar. 18	George Harbor	....	Steamer	Mariners' Harbor, Staten Island, N. Y.	
Mar. 18	Gannet	....	Mine Sweeper	Todd Shipyard Corporation, Tebo Basin, Brooklyn, N. Y.	U. S. Navy
Mar. 20	Puyallup	3500	Ferris Steamer	....	Emergency Fleet Corporation
Mar. 21	Bancroft	....	Destroyer	Bethlehem Shipbuilding Corporation, Quincy, Mass.	U. S. Navy
Mar. 22	Sarcoxie	7500	Cargo Steamer	American International Shipbuilding Corporation, Hog Island, Pa.	Emergency Fleet Corporation
Mar. 22	Tern	....	Mine Sweeper	The Gas Engine & Power Company and Chas. L. Seabury and Company, Morris Heights, N. Y.	U. S. Navy
Mar. 27	Strathnaver	....	Steamer	Downey Shipbuilding Corporation, Arlington, Staten Island	Emergency Fleet Corporation
Mar. ..	Daulis	3500	Ferris	Sommarstrom Shipbuilding Company, Columbia City	Emergency Fleet Corporation
Mar. ..	Bound Brook	....	Cargo Vessel	Submarine Boat Corporation, Newark, N. J.	Emergency Fleet Corporation
Mar. ..	N. P. Doane	....	Tug	Adams Shipbuilding Co., East Boothbay, Me.	Doane Towboat Co.
Mar. ..	I. J. Merritt	....	Tug	A. C. Brown & Sons, Tottenville, S. I.	Merritt & Chapman Derrick & Wrecking Company

Marine Construction News of the Month

Ships, Shipyards and Shipyard Improvements—Terminal Projects—Launchings—Government Contracts

NEW SHIP CONTRACTS

The Todd Shipyards Corporation, 15 Whitehall street, New York, has received an order from the United States Navy Department to build six self-propelled steel oil barges.

Oceanic Steamship Company, it is reported, is planning to build twelve steel steamers of 8,000 tons each. The work will probably be placed with the Pacific Coast builders.

See also contracts noted on page 302 of this issue.

NEW SHIPBUILDING PLANTS

New St. Louis Shipbuilding Company Formed

Contract for the building of the four remaining self-propelled cargo barges to be operated by the United States Railroad Administration in the Mississippi-Warrior barge service has been let to an organization incorporated as the St. Louis Boat & Engineering Company, St. Louis, Mo. This organization was formed by the following men: Walter A. Windsor, president of the Marietta Manufacturing Company, Point Pleasant, W. Va.; Albert Ruemelli, president of the Ruemelli-Dawley Manufacturing Company, St. Louis, Mo., and Edward A. Faust, former president of the Standard Shipbuilding Company, New York City. The company expects to erect an assembling yard at St. Louis, utilizing the facilities of the parent companies for fabrication work. Cox & Stevens, 15 William street, New York, are the naval architects, representing the United States Railroad Administration, and C. E. Smith & Company, St. Louis, Mo., is the consulting firm for the contractors.

Victoria, B. C., to Have Large Drydock

It is reported that capitalists of Seattle, Wash., are backing an enterprise to have the Dominion Government at Ottawa sanction the construction of a big steel drydock capable of handling vessels up to 25,000 tons at Victoria, B. C.

The Gaspe Shipbuilding & Dry Dock Company, Ltd., Gaspe, Quebec, has been founded to build boats, marine engines, etc., at that place. The company, which is capitalized at $7,500,000, has been organized by T. H. Jopling, H. J. Hyman and Alfred Lacouvee.

The Harbor & Marine Company, Ltd., is the name of the new concern which is being formed at Vancouver, B. C., to build ships for the Canadian Government. The contracts for ships were let to the Victoria Machinery Depot some time ago. C. J. V. Spratt will act as head of both companies.

Bartlett Hayward Company Repair Plant

It is reported that the Bartlett Hay-Ward Company, Baltimore, Md., has completed negotiations for the purchase of land on the south side of the basin in Anne Arundel County, from the Frank Furst Realty Company. The site will be used for a ship repair shop. It is stated that the construction will cost $4,000,000 to $5,000,000.

Wisconsin Shipyard

The Anchor Shipbuilding Company, Washburn, Wis., is in the market for machinery and equipment to be installed in the yards now building on the Crequamegon Bay shore.

Kelly Dry Dock

Work has been begun upon the marine railways for the Kelly Dry Dock & Shipbuilding Company of Mobile, Ala. When completed the plant will have cost about $150,000, and will furnish employment for approximately 250 men. The plant is on the east side of the river, opposite the Mobile & Ohio docks. The docks will be able to handle steel or wooden vessels drawing 18 feet of water and upwards, with capacity of 1,800 to 2,000 tons.

New California Yards

The French-American Shipbuilding Corporation, Los Angeles, Cal., has been organized for the construction of concrete steel vessels to be built at its proposed shipyard, to be located in San Pedro. The initial expenditure for the building construction is about $100,000. The company, which is capitalized at $2,000,000, has appointed W. E. Russell president.

The Santiago Shipbuilding & Dry Dock Company, Santiago, Cal., has received permission to build a shipbuilding and repair plant at the tide lands. About $100,000 will be spent in the preliminary construction, it is reported.

SHIPYARD EXTENSIONS

Contract for building extensions to shipbuilding slips Nos. 2 and 3 at the League Island Navy Yard, Philadelphia, Pa., has been let to W. H. McCloskey, Jr., Philadelphia. The work will include reinforced concrete additions, 122 by 170 feet, with trigger pit and shop facilities. The improvements will cost $295,040.

The Mainland Engineering Company, Ltd., 422 Railway street, Vancouver, B. C., is erecting new shops at Cool Harbor, where the company will break into ship repair work. Propellers have been the specialty of the company up to this time.

Morrison & Beck, 149 South Dearborn street, Chicago, Ill., opened bids about March 15 for the construction of a 80 by 600-foot reinforced concrete floating drydock to be built at Green Bay, Wis., for C. Hartman Company, to cost about $500,000. Twelve centrifugal motor-driven pumps of 1,200 gallons capacity will be installed, and sixteen motor-driven capstans.

The National Concrete Boat Company, Norfolk, Va., has arranged for the construction of six shipbuilding berths at its new plant on the Gilmerton branch of the Elizabeth River, near the Portsmouth Navy Yard. Three of the ways will be used for concrete barges, and the others for tugboats, steamers and vessels of other types. The company has been capitalized at $300,000. H. B. Speir is general manager.

Large Eight-Section Dry Dock

The Cossey shipyard, Tottenville, S. I., has begun work on the second section of the 10,000-ton drydock now being built for the Todd Shipbuilding Corporation, Brooklyn, N. Y. The dock will consist of eight sections, each 90 feet long, 114 feet wide, and 45 feet high; it will contain about 3,000,000 feet of lumber, and will be so constructed that additional sections may be added at a later date. This is the third drydock to be built at the Cossey yard for the Todd Shipbuilding Corporation.

The Astoria Marine Iron Works, Astoria, Ore., has received a contract from the Shipping Board to build a marine railway capable of accommodating vessels up to 10,000 tons gross.

Buffalo Dry Dock Company, Buffalo, N. Y., is preparing to erect a punch shop to cost about $20,000 at its Buffalo yards.

$1,500,000 Yard Shop at Mare Island

Approval has been given by the Bureau of Yards and Docks, Navy Department, for the building of a structural shop building at Mare Island Navy Yard,

California, to cost $1,500,000. Plans were available on February 24. These called for at least $1,000,000 of steel work in the construction.

$1,000,000 Extension on the Coast

It has been reported that the Moore Shipbuilding Company, Oakland, Cal., which is specializing in the building of 9,400-ton cargo vessels and 10,000-ton tankers, is contemplating extensive enlargement of the present plant, in which at least $1,000,000 will be expended.

Launching Basins Enlarged

A 21-foot launching basin, which runs from Port Aransas to Rockfort, Tex., where the Heldenfels Brothers are constructing 3,500-ton wooden vessels for the Emergency Fleet Corporation, was completed in the middle of February.

The basin of the Peninsula Shipbuilding Company, Portland, Ore., and the water area at the rear of the fitting-out dock, are being dredged to make it possible for vessels to be berthed along the side of the dock.

The Ames Shipbuilding & Dry Dock Company, Seattle, Wash., has received assignment of water area leases by A. M. Gund, of that city.

Bethlehem Steel Corporation's Drydock Completed

The largest floating drydock in the United States, designed by William T. Donnelly, is about completed at the Sparrow's Point plant of the Bethlehem Steel Corporation. The new drydock, which is over 600 feet long, will be able to handle vessels up to 20,000 tons deadweight capacity. The engineers believe that it will be possible to submerge and bring up the dock within thirty minutes.

Machine Shop Enlargements

The Marine Engineering & Drydock Company, Providence, R. I., has ar- two-story building, about 60 by 300 feet, two-story building, about 60 by 300 feet. The structure will be equipped as a machine shop and for other features of boat repair operations.

Oscar Daniels Company, Tampa, Fla., which has an order for ten 9,500-ton freighters, 416 feet long, 54 feet beam, is planning to build a well-equipped boiler shop at the yards.

Ira S. Bushey & Sons, 764 Court street, Brooklyn, N. Y., operating a shipyard at the foot of Twentieth street, has filed plans for the construction of a new one-story tool shop at its Court street docks. The company recently increased its capital from $100,000 to $1,000,000 to provide for general expansion and increased facilities at the works.

The Birmingham Steel Corporation, Birmingham, Ala., has begun construction work on a templet building one story high, 60 by 120 feet.

Government Extensions

The Navy Department is planing for the construction of a spar shop at Portsmouth, N. H., to cost about $60,000. The drawings are now completed by the consulting engineer.

The Carroll Electric Company, Washington, D. C., has entered the lowest bid for installing a power house at the Navy Yard, Portsmouth, N. H., at $42,800.

The Bureau of Yards and Docks, Navy Department, Washington, D. C., has received five bids for the construction of a paint shop and storage warehouse at the naval station at Algiers, Ala., as follows: James A. Petty, $22,000; John J. Reiss, $26,600; Crowl Construction Company, $27,989; Richard McCarthy, Jr., $28,970, and Lionel Favret, $31,855.25.

The Navy Department, Bureau of Yards and Docks, Washington, D. C., is about ready to discuss plans for the construction of a galvanizing plant at the Norfolk Navy Yard, to cost about $100,000.

The Navy Department is planning to increase the electric power plant at the Pensacola Navy Yard, Pensacola, Fla. About $75,000 will be expended for the improvement.

New Southern Yard Ready for Actual Shipbuilding

The shipbuilding plant of the Chickasaw Shipbuilding Company, Mobile, Ala., is now completed and ready for the building of steel ships. Steel is being forwarded from the Fairfield plant, where it is rolled for the Chickasaw yards, but the actual work of fabrication has not yet been undertaken. Sixteen hundred houses have been built near the plant to accommodate the necessary force to be employed.

PORT IMPROVEMENTS

Extensive Port Improvements Under Way at Philadelphia

The port of Philadelphia is forging ahead at a rapid pace in carrying out the details of its extensive port development.

Bids have been solicited and were opened on March 27, 1919, for the construction of two additional piers of the Moyamensing Group, known as Piers Nos. 82 and 84, South Delaware Wharves. These piers will be 300 feet wide by 900 feet long. The contract at this time is for the substructure only. Bulkheads will connect the two piers and extend to the north and south of them approximately 200 feet. The estimated cost of the construction of the two piers is $3,000,000.

Plans and specifications are also being prepared for the construction of a double-deck pier to be built at the foot of Allegheny avenue, which will be known as Pier No. 127, North Delaware Wharves. Bids are not yet solicited upon this construction. The estimated cost is about $1,000,000.

F. W. Marks Construction Company, Finance building, has been awarded the contract for building Kennelworth street pier at Philadelphia, Pa. The construction will cost $908,420.

Bids for Improvements at Portland, Ore., Advertised

The Commission of Public Docks, Portland, Ore., has authorized a 300-foot extension to Pier 1, upon which will be built a transit shed 180 feet wide. This 1,200-foot pier, the outer half of which has a two-level structure with a transit shed 180 feet in width, has just been completed. The shed over the remaining area will be completed shortly. Construction of Pier 2, which will be 1,500 feet long by 225 feet wide, has also been authorized. For the present this will be used as an open pier for handling bulk freight and lumber. Bids for both these improvements were advertised about March 24. In the new construction provision is made for installation of gantry cranes, sheerlegs, etc. G. B. Hegardt is the engineer in charge.

J. A. McEachern Company, Portland, Ore., has completed Pier No. 1 of the St. John's Municipal Ferry. The driving of test piles on the site of Piers 2 and 3 is proceeding. The Automatic Sprinkler Company offered the lowest bid for the installation of sprinklers in the warehouses on Pier No. 1, at $54,904.

Fourteen 1,000-Foot Piers for New York Harbor

Frank E. Lonas, 1790 Broadway, New York, has presented a proposition to the Sinking Fund Commission of New York City for the building of fourteen 1,000-foot piers in Jamaica Bay. He proposes to pay $1,050,000 for a fifty-year lease of the property. At the end of this time piers and improvements are to be turned over to the city free of cost. In turn Mr. Lonas asks that the city give the builders tax exemption on the property during the fifty years' lease, and that a channel be dredged in Jamaica Bay 1,500 feet wide by 30 feet deep, using the excavated material for filling in around the proposed piers.

Bids for New York Terminal Improvements Costing $400,000 About to be Opened

During March contracts for $400,000 worth of terminal improvements to be built around New York harbor will be let. Lewis Nixon, State Superintendent of Public Works, gives out details of the work as follows: Barge Canal terminal and frame freight house, Flushing, $162,590; grading and paving at terminal sites at Mott Haven, Greenpoint and Gowanus Bay, $94,340; erection of two 1½-ton electric overhead wharf cranes on Pier 6, New York, $28,000; erection of electric capstans and trolley hoists along the canal, position not yet designated, $15,000; erecting four 3-ton, semi-portable, revolving jib cranes, two each at Greenpoint and West Fifty-third street, New York, $92,589; constructing barge terminal freight shed at Pier 93, West Fifty-third street, $53,969; and installing battery-charging motor generator sets, $7,800.

Drydocks for Philadelphia

The Girard Dry Dock & Construction Company, Philadelphia, is one of the bidders for the management of two drydocks which are to be constructed at Philadelphia aided by funds from the Emergency Fleet Corporation. The company proposes to invest $1,000,000 immediately and the same amount at a later time. The company holds a fifty-year lease on 1,400 feet of water frontage, which has been approved as a site for the new construction. Construction plans have been completed by the Hugh Nawn Construction Company, which guarantees that facilities for repairing ships can be furnished in six months. The project will cost about $5,000,000. The Emergency Fleet Corporation is prepared to furnish 70 percent of the capital at 6 percent interest for ten years.

$4,000,000 Dry Dock at Charleston

Bids will be advertised about April 4 for the construction of the large $4,000,000 dry dock which was authorized by the last Congress to be built at Charleston, S. C.

Harbor Development for Portland, Me., Under Consideration

The State Board Commission has recommended that bonds to the amount of $1,500,000 be authorized for the initial cost for developing Portland, Me., harbor. It is recommended that a pier be constructed to extend from Commercial street to the present harbor line, a distance of 1,000 feet. The Commission points out that the advantages accruing to the city of Portland through the location of the pier at that port should make it worth while for the city to provide a site for the pier and railroad connections without expense to the State.

Officials of the Canadian Pacific Ocean Steamship Line are seriously considering the utilization of Portland, Me., as the Eastern American terminal for this service. The plan provides for the location of a State pier in Portland, with railway connections to be developed from the Maine Central Railroad at Cookshire Junction. The most up-to-date cargo-handling facilities are to be installed.

$2,000,000 for Piers at Tacoma

The city of Tacoma, Washington, is planning to spend about $2,000,000 in the construction of two piers. One pier will be used for open storage and assembling of lumber cargoes. It is proposed that the other pier shall have a transit shed constructed on one side with the necessary mechanical freight-handling equipment needed for extensive shipping. The other side will be developed in the future. Frank A. Walsh is city engineer.

Seattle Plans in Abeyance

Consummation of the plans for the enlargement of Smith Cove, Seattle, is being held up by the delay of the State Legislature in the passing of a bill which will give the city further bonding privilege. The Harbor Commission is arranging with the representatives of the United States Shipping Board to provide extra warehouse storage space.

Buffalo Plans Port Expansion

An organization, composed of vessel owners, elevator managers and officials from steel and iron industries of Buffalo, N. Y., has been formed to advance river and harbor improvements at that city. Edwin T. Douglass has been appointed temporary chairman of the organization, known as the Buffalo Harbor Improvement Association.

Terminals for Oil Companies

Contract has been let to the Raymond Concrete Pile Company, Munsey building, Baltimore, for the building of a reinforced concrete and steel pier for the Standard Oil Company, to cost approximately $400,000. A one-story shed of concrete will be erected on the pier.

The General Petroleum Corporation, Seattle, Wash., is planning to spend $400,000 for the erection of an oil storage plant and a 600-foot ocean wharf near the northwest corner of Harbor Island. W. A. Dudley is district manager.

The Texas Company, Jacksonville, Fla., has commenced important terminal improvements at this port, including the building of additional docks and warehouses on property previously owned by Upchurch Lumber Company. The Mexican Petroleum Company is constructing a barge of 2,000-barrel capacity to be operated at the Talleyrand avenue terminal.

The Mexican Petroleum Company has applied to the Harbor Board of Baltimore, Md., for permission to construct a bulkhead at Fishing Point. It is reported that a refinery to cost about $1,000,000 will be built on the site. A pier for the use of the company's steamers is also reported to be in contemplation. Application for building privilege has not yet been entered. The Mexican Petroleum Company is capitalized at $78,000,000.

Navy Department Contracts Awarded

The Bureau of Yards and Docks, Navy Department, Washington, D. C., has awarded the following contracts:

Building of a paint shop and paint storage building at New Orleans, to James A. Petty, for $22,000; installation of piping and equipment and a power plant at New York, to the Lord Construction Company, New York, for $42,069; extension of pneumatic tube system at Hampton Roads, Va., to Standard Carrier Company, New York, $27,637; boiler installation at Pearl Harbor, Hawaii, to Mr. Ewery, Hilo, Hawaii, $1,609; installation of refrigerating plant equipment at Wards Island, N. Y., to Frick Company, Waynesboro, Pa., for $21,074; additions to crane runway on shipbuilding slips 2 and 3, at Philadelphia, Pa., to the American Bridge Company, Washington, D. C., for $137,300; building of substructure for foundry and piers A, B and C, Philadelphia, Pa., to the Wark Company, Philadelphia, Pa., for $7,695; five bronze propellers for 7,500-ton concrete tankers, to William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., for the lump sum of $39,295; five propellers of the same type to Paul S. Reeves & Company, Inc., Philadelphia, Pa., for the lump sum of $38,112; special work in the building of a power plant at the New York Navy Yard, to cost $9,925, to the Guarantee Construction Company, 140 Cedar street, N. Y.

The McLean Construction Company, Fidelity building, Baltimore, Md., has received a contract for building a boat basin and wharf bulkhead at Indianhead, Md., for the Navy Department. The construction will cost $38,900.

G. A. Fuller Company, 131 State street, Boston, Mass., has received a contract for building a storage shed and steel shack at the yards of the Boston Navy Yard. The construction will cost about $75,000.

New Port Projects

The city of New London, Conn., through a special committee of bankers appointed by Mayor Morgan, has decided to limit the issue of bonds for port improvement to $500,000 for the present. Further limitation has been suggested in restricting the amount of bonds to be expended in this connection to the sum of $200,000, or $250,000 during any one year.

Cincinnati, Ohio, has passed an ordinance providing for the expenditure of $178,500 for water-front improvements.

The city of Tuscaloosa, Ala., will issue bonds to the amount of $25,000 for the purchase of a wharf site east of the waterworks above Lock 12. A bond issue of $50,000 is also available to erect a suitable landing and equip it with modern cargo-handling machinery.

New Orleans, La., Port Commissioners have been authorized to issue bonds for $8,000,000 to be expended in finishing the construction of the Industrial Canal, and for constructing coal storage facilities, enlarging cotton warehouses and installing coal-handling machinery.

Fort Peirce, Fla., has voted to issue bonds to the extent of $80,000 to construct an inlet from the Atlantic Ocean into Indianhead River. McMullen & Horton are the contractors.

Coos Bay, Ore., is considering the construction of a dock for the use of vessels entering that port.

Contract for building a pier and bulkhead in Bodkin Creek, Md., was awarded to Dorsey Miller Company, Baltimore, Md., on March 6.

Government Work in Prospect

Proposals were opened on March 8 for furnishing two steel boiler feed tanks to the Emergency Fleet Corporation on Inquiry No. 1303-H. No award is yet announced.

The Bureau of Yards and Docks, Navy Department, Washington, D. C.,

has invited proposals on the erection of one 2,300,000-gallon steel water tank at an estimated cost of $15,000, at Providence, R. I.

Proposals are open for the building of a timber wharf at Norfolk, Va., estimated cost of which is now given as $80,000.

A $15,000 water tank is to be erected at Newport, R. I., under the direction of the Bureau of Yards and Docks, Navy Department, Washington, D. C.

A fire protection system to cost about $30,000 is to be installed in the Navy Yard, Philadelphia, Pa., under the direction of the Bureau of Yards and Docks, Navy Department, Washington, D. C.

At the galvanizing plant to be built at Norfolk, Va., several large cranes are to be installed, for which bids are now open at the Bureau of Yards and Docks, Navy Department, Washington, D. C.

The Bureau of Yards and Docks, Navy Department, Washington, D. C., is about to open proposals covering the installation of two 15-ton electric traveling cranes at an estimated cost of $70,000.

The Bureau of Yards and Docks, Navy Department, Washington, D. C., will open proposals on March 24 for the building of a wet basin boat shed at Pensacola, Fla., at an estimated cost of $60,000.

Bids are open after March 17 for the building of a steamship and navigation building at Annapolis, Md., for the Navy Department. The construction will cost about $800,000.

The army warehouse and wharf at New Orleans, La., will be completed. Work was temporarily suspended at the yard pending a decision of the War Department.

The Government will rebuild the wharf and quarantine station at Port Morgan, Mobile, Ala. The construction will cost about $20,000. T. Judge is the contractor.

The Vilter Manufacturing Company, 872 Clinton street, Milwaukee, Wis., has entered the lowest bid of $20,935 for the building of a refrigerating plant equipment at Ward's Island, New York, for the Navy Yard.

The building of a $500,000 dry dock by the Bruce Dry Dock Company, Pensacola, Fla., has been approved by the Shipping Board.

Bids on Rudders Withdrawn

The United States Shipping Board has announced to prospective bidders on inquiry No. 1270, revised (date February 28, 1919), for forty rudders to be placed on 3,500-ton wood ships, that no award will be made on the above bids, since a number of changes in the design of steel rudders are contemplated.

Barge Canal Terminal

The lowest bid for the construction of the barge canal terminal at Greenpoint, Brooklyn, was received from Post & McCord, New York, for $75,718.94. The State engineers had placed the cost of the work at approximately $99,710.

The Matson Navigation Company has requested the Board of State Harbor Commissioners of California to install electric wiring on Piers Nos. 30 and 32 in San Francisco harbor. The company is in the market for various types of electrically-operated labor-saving devices which will be installed on these piers.

A new $125,000 coal hoist, recently installed at the L. N. Railroad Company's docks, Mobile, Ala., makes it possible to unload two coal cars every fifteen minutes. This represents one of the many improvements which have been installed to provide for adequate handling of the Warrior Barge Canal shipments.

Crane Transferring Costs in the United States

As evidence of the cost of cargo transference by adequate crane facilities, the harbor master of the city of Beaumont reports that on March 6 there was handled from ship to pier the following amount of freight: 2103 barrels of asphalt, lift 40 feet, swing 50 feet, in eight hours and thirty minutes at a cost of $25.16 to the shippers for the use of the gantry cranes, which was at the rate of $.002 per pound or $.012 per barrel. The crane expense to the shipper including the profit accruing to the city for the use of the crane is about 4.4 cents per ton.

Larger Ships to Be Built Under the New Programme

It has been reported that under the new shipbuilding programme the Northwest Steel Company, Portland, Ore., and the Columbia River Shipbuilding Corporation, Portland, will each be awarded contracts for the building of five 12,500-ton steel vessels. The vessels will be of a three-decker type and carry reciprocating engines of 5,500 horsepower.

The G. M. Standifer Construction Corporation, Vancouver, B. C., which had previously received cancellation orders on five of the fifteen ships under construction, has been asked to furnish a report of the material on hand for these ships. It is reported that three will probably be constructed as originally planned.

Reinstatements have been received by the Northwest Steel Company for two vessels on the original contract of ten, by the Columbia River Shipbuilding Corporation for two vessels on the original contract of eight, and by the Albania Engine & Machine Works for two on the original contract for four.

General Manager Frank McLaughlin, of the Mobile Shipbuilding Company, Mobile, Ala., has reported that instead of the cancellation of contracts which provide for the building of twenty-four 5,000-ton steel vessels to be built at that yard, the contract will probably be changed so that twelve of the ships will be of 9,600 tons each.

It was announced at the monthly meeting of the American Ship Building Company, Cleveland, O., on February 26, that no change in the shipbuilding programme at that yard was expected.

When relieved of Government work the Groton Iron Works, Groton, Conn., plans to build standard vessels for the United States Steamship Company, which is controlled by C. W. Morse. The rumor that ships built at the Groton and Noank yards of the Groton Iron Works, and at the yards of the Virginia Shipbuilding Corporation, Alexandria, Va., were to be purchased by a company known as the American-Canadian Corporation for $76,000,000, is reported to be without foundation.

New Plan for Conversion of Wood Ships Halts Work on Ship Machinery

The order of the Emergency Fleet Corporation, affecting the California, Oregon and Washington districts, to convert the wood ships now building into schooners and barges, has temporarily stopped all work at the outfitting plants on the coast. The Astoria Marine Iron Works, Astoria, Ore., which is installing machinery upon boats built in that locality, the Grant-Smith-Porter Company, Portland, Ore., which is equipping vessels built at the Portland and St. Johns yards, and the Pacific Marine Iron Works, which has contracts for fitting out hulls built at St. Helens and Columbia City, have closed down temporarily until the extent of the conversions is known. The Willamette Iron Works, which had contracts for outfitting six of the vessels being constructed by the G. M. Standifer Construction Corporation, is also affected. Orders covering engines under construction at the Pacific Marine Iron Works for the G. M. Standifer Construction Corporation and for the Supple-Ballin Shipbuilding Company's ships, are suspended pending further reports.

As to wooden vessels, only cancellations for twenty-six vessels have been put through. Thirty-eight schooners or barkentines are now on the ways, and eighty-eight have already been delivered.

The Coos Bay Shipbuilding Company, Marshfield, Ore., has received reinstatement on contracts for building two of the Ferris type vessels under construction at its yard, since work was far advanced on these particular vessels.

The Terry Shipbuilding Company, Savannah, Ga., has temporarily laid off about 700 men at that plant pending further orders from the Emergency Fleet Corporation regarding the disposition of ship hulls now in construction at that yard.

J. A. Rosseter, director general of operations of the Shipping Board, and Franklin D. Roosevelt, Assistant Secretary of the Navy, have stated that they will use every opportunity to keep shipyards, which are temporarily slack in work, busy upon repair work.

General Shipyard News

The Columbia Engineering Works, Portland, Ore., delivered the four-masted schooner building for C. Christensen, 32 Broadway, New York, on March 20. The company is also building a 1,000-ton twin screw motorship for the same party.

M. M. Davis & Son, Inc., Solomons, Md., during the year 1918 launched twenty vessels—one 1,800-ton barge for the Northern Transportation Company, one tug for the Bethlehem Steel Corporation, fourteen 600-ton barges for the Quartermaster's Department of the United States Army, and four tugs for the Emergency Fleet Corporation.

The company has under contract for delivery to the Emergency Fleet Corporation eight tugs, 133 feet in length.

It is rumored that the Skinner & Eddy Corporation, Seattle, Wash., has taken over the contracts from the firm of J. Coughlan & Sons, Vancouver, B. C. The latter company was building steel ships of 8,800 tons.

In a statement given out by the shipyard owners in Seattle, Tacoma and Aberdeen, Wash., on March 11, on which day it was expected that the shipyards would again be opened for construction work, the employers estimated that the loss in wages alone during the present shut-down has amounted to $10,950,000.

The second annual convention of the Mississippi Valley Waterways Association will be held in St. Louis, Mo., at the Hotel Statler, on April 17 and 18.

PERSONALS

The Institution of Civil Engineers, London, elected upon its roll of distinguished honorary members on January 28 the following: Marshal Foch, O. M.; Field Marshal Sir Douglas Haig, K. T., and Admiral Viscount Jellicoe, of Scapa, G. C. B., O. M.

Vice Admiral Fred W. Grant has been assigned as commandant of the Washington Navy Yard and superintendent of the arsenal there.

Josephus Daniels, Secretary of the Navy, left for Europe on March 15, accompanied by Rear Admiral D. W. Taylor, head of the Bureau of Construction and Repair, and Rear Admiral Robert S. Griffin, head of the Bureau of Steam Engineering, to study European naval construction with a view to formulating plans for the future naval programme of the United States.

General Guy E. Tripp, formerly president of the Board of Directors of the Westinghouse Electric and Manufacturing Company, has been decorated by the United States Government with the distinguished service medal for his excellent work in systematizing methods and practice in the Ordnance Department.

Captain J. F. Blain has resigned as manager of the North Pacific district of the Emergency Fleet Corporation, the resignation to take effect April 1.

Formal announcement was made on March 9 of the resignation of Bainbridge Colby from the United States Shipping Board, in which organization he has served as commissioner since August 8, 1917. No successor has yet been announced.

Captain W. A. Magee, who has been active in the wood ship division of the United States Shipping Board, will succeed Captain Blain as manager of the Pacific Coast division.

Rear Admiral Robinson will succeed Captain William R. Rush as commandant at the Boston Navy Yard.

J. J. Davis, secretary-treasurer of the Galveston Wharf Company, has been appointed agent for the United States Shipping Board in Galveston with jurisdiction over Texas territory.

Major Marshall R. Pugh, who previously served as post engineer at the Bordeaux embarkation camp, is now engaged in work with the United States Shipping Board in the contract department.

Rear Admiral James H. Glennon has been appointed Commander of the third naval district with headquarters at New York, following the retirement of Rear Admiral Nathaniel R. Usher.

Capt. Nicholas Jelusich, who has acted as inspector for the Reading Company at the Coastwise Shpibuilding Company's yards, Baltimore, has returned to Philadelphia. During his appointment in the yard he supervised the construction of fifty-two ocean-going vessels. Ten of these, aggregating 17,000 tons, were built at the Locust Point yard of the Coastwise Shipbuilding Company.

Melvin P. Billups has been appointed assistant director of the Southern Division of Operation of the United States Shipping Board. His appointment became effective February 15.

United States Engineer W. D. Fairchild, in charge of locks and dams on the Monongahela River, is incapacitated for work on account of a severe breakdown.

H. L. Stout, chief investigator of the plant protection bureau of the United States Shipping Board, stationed at San Francisco, has resigned.

Christopher M. Gordon has again been appointed president of the Los Angeles Harbor Commission, Los Angeles, Cal.

Capt. W. N. Hart has been named superintendent of the Hampton Roads district of the United States Shipping Board.

Maj. Gen. William M. Black, chief of the army engineers, has been appointed chairman of the Port and Harbor Facilities Division of the Shipping Board.

Maj. John C. Cushing, it is reported, will succeed A. B. Clegg as assistant director of the Shipping Board's Division of Operations in New York.

Henry W. B. Zundt, manager of the New York branch of the Department of Shipping Information of the United States Shipping Board Emergency Fleet Corporation, has tendered his resignation to take effect April 1.

William T. Donnelly, consulting engineer, New York City, has been retained to make a survey of the harbor of Mobile, and to suggest necessary harbor improvements. The survey will include the examination of the Arlington dock development plans and a report of the work already completed and that still in contemplation.

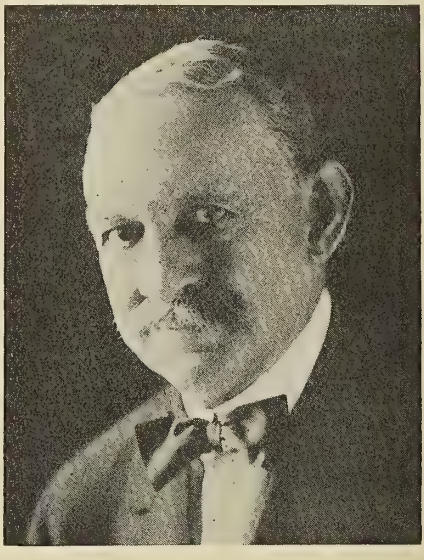
John Torrence has been elected president of the Shipping Federation of Canada.

Col. Peter O. Knight, of Tampa, Fla., who has been active for several months as general counsel and vice-president of the American International Shipbuilding Corporation at Hog Island, has returned to Tampa. In the future he will be at Hog Island only when particular circumstances make his presence necessary.

OBITUARY

Henry Rogers Mallory, one of the most widely-known steamship men in America, formerly president of the company bearing his name, and retired president of the Atlantic Gulf & West Indies Steamship Lines, died suddenly on March 4 at Winter Park, Fla.

Mr. Mallory became president of the New York & Texas Steamship Company in 1893. In 1906 the Mallory interests were merged with several other large and important steamship companies. In 1908 a reorganization of the members composing the various steamship lines was



Henry R. Mallory

carried out. Mr. Mallory, who was chairman of the reorganization committee, placed the business of the present firm on a substantial foundation. In 1915, when Mr. Mallory retired from active business life, it was reported that the Atlantic Gulf & West Indies Lines were worth more than $100,000,000.

Hilary A. Herbert, Secretary of the Navy during Cleveland's second administration, died at Tampa, Fla., March 6.

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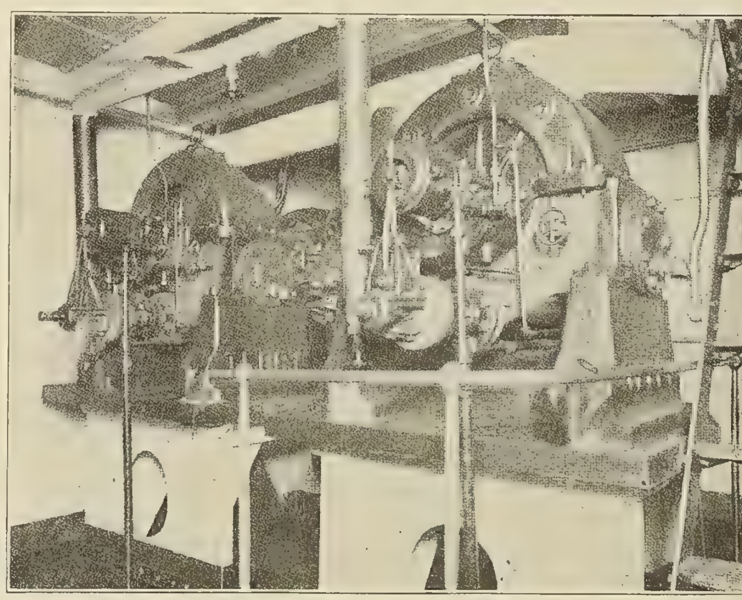

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More Cancellations

IN a statement issued on April 25, the chairman of the Shipping Board announced that in figuring out the balancing of the merchant fleet it is now found necessary to cancel an additional 2,000,000 tons of steel ships and that the Shipping Board is now considering cancelling all contracts where keels have not actually been laid. As shown in our last issue, previous cancellations of contracts for steel vessels since the signing of the armistice amounted to over 2,000,000 tons, so the latest order reduces the steel shipbuilding programme by over 4,000,000 tons, with the prospect of more cancellations to follow.

With the return of peace conditions, some such revision of the Government shipbuilding programme was not unlooked for, because of the fact that previous unfilled contracts had been let at war prices. In some of the old and established yards the Shipping Board is paying from $195 (40/12/6) to $225 (46/17/6) per ton for cargo steamships and oil tankers, and in some of the new and inexperienced yards as much as $300 (62/10/0) per ton for cargo ships. Future tonnage for the Shipping Board obviously should be built on peace prices rather than on war prices.

Let the Shipyards Take Foreign Contracts

ACTING under the direction of the council, the executive committee of the National Merchant Marine Association recently filed with the United States Shipping Board the following resolution:

"*Resolved,* that in the opinion of the council of the National Merchant Marine Association all American shipyards should be allowed to take orders for the construction of ships for foreign buyers in cases where neither the United States Shipping Board Emergency Fleet Corporation nor domestic buyers are able or willing to furnish the yards with orders to keep the ways occupied; and that a copy of this resolution be transmitted to the United States Shipping Board for action."

In acknowledging receipt of this resolution, the acting secretary of the Shipping Board stated that the present attitude of the Board in the matter of declining to grant permits for construction for foreign account is based on the expressed desires of the President of the United States that no orders for construction of steel ships for foreigners be placed in American yards. The present opinion in this matter is predicated on the yet unsettled condition of world affairs and the present very acute situation with respect to steel tonnage. He concludes by saying that America needs every ship that she now has or that can be built in the near future, and it is deemed wise to conserve for the present the shipbuilding facilities of the United States for the construction of vessels to fly the American flag.

The attitude of the Shipping Board, as expressed in the foregoing, would undoubtedly be heartily approved by all shipbuilders if it were not for the fact Government contracts in many yards, and especially in some of those on the Great Lakes, will soon be completed and ways will be vacant for other work. Domestic buyers are not showing any tendency to place orders in the immediate future, or at least until the policy of operating the merchant marine has been settled. There is the prospect, then, of idle ways in some shipbuilding districts and consequent reduction of trained shipyard forces, a condition that will not tend to conserve American shipbuilding facilities. Shipbuilders realize that the only way in which their organizaton, equipment and trained personnel can be conserved is by keeping the yards fully occupied with work. Under existing conditions, therefore, in cases where neither the Government nor domestic buyers are able or willing to furnish the yards with orders, it would seem the height of folly not to permit such yards to accept orders for foreign account and thereby enable them to keep their plants in full operation at a high state of efficiency against the time when their facilities will be urgently needed for domestic work.

Shipbuilding Prospects

IN the discussion of foreign trade at the Sixth National Foreign Trade Convention recently held in Chicago, ships were admitted to be the controlling factor, and the question of the economical building and operation of ships received a large amount of attention. Speaking from the point of view of a shipbuilder, Homer L. Ferguson, president of the Newport News Shipbuilding & Dry Dock Company, pointed out that under the necessity and stress of war the shipbuilding capacity of the United States has been developed to a point where it can produce ships at a rate in excess of the world's requirements, but that at present American shipbuilding is at the peak of its productive capacity and many shipyards are facing the cessation of work during the current year, as all contracts on hand should be completed during 1920, and many earlier than that.

"The shipyards of the country," said Mr. Ferguson, "have equipment to build vessels in any size up to the largest vessel afloat, and to build the smaller sizes of less than 10,000 tons deadweight in any number required. The men who have been employed in the shipyards will remain if steady employment at good wages is assured. The wages of first-class mechanics engaged in shipbuilding in Great Britain, as recently reported by a representative British shipbuilder, are $20 (4/3/4) to $25 (5/4/2) per week, whereas the wages of similar mechanics in the United States are from $34 (7/1/8) to $40 (8/6/8) per week. American shipbuilders have for many years been urged to build ships as cheaply as they are built in Europe, and many of the foremost industrial authorities in this country have argued that we should compete with them in shipbuilding as we do in many other lines of manufac-

turing. Repetition or manufacturing processes in a shipyard, however, are exceedingly small, and, except for his ancient aversion to labor-saving tools, the European workman in a shipyard has had the reputation among shipbuilders of doing as much work as an American workman; their greater skill and experience in the minor trades offset to a large extent our use of more modern equipment. American shipowners state that it is very difficult, if not impossible, for them to compete with foreign owners on account of high wages paid and more men required. It is interesting in this connection to note that the wages of seamen constitute probably from 7 to 12 percent of the cost of operation of a vessel, whereas in the building of a vessel in a shipyard from 40 to 50 percent of the total cost is labor."

In discussing the possibilities of the future of the shipbuilding industry, Mr. Ferguson did not consider the outlook particularly bright. A large amount of capital has been invested in building new and enlarging old shipyards, but it has been invested under abnormal conditions and is greatly in excess of the amount which would have been required in normal times. Unless it is written off, plenty of work at good prices will be necessary to keep some of the yards going on acount of the high fixed charges. The recent reduction in the price of steel has not brought it within the range of 1913 prices, and the prices of shipbuilding material and equipment are on a high level. Shipbuilding wages have gone up over 150 percent. The cost of steel vessels per ton, therefore, will be two or three times the pre-war prices until industrial conditions change. On the other hand, Mr. Ferguson pointed out a lesson that should have been learned from the war, and which, if heeded, should be a source of encouragement for shipbuilders. It is that there is not time after war is declared to build the necessary ships, and a large output of ships must be maintained in peace times to keep the shipyards at a high state of efficiency—in other words, we must be prepared.

Shipbuilding in the future, according to Mr. Ferguson, will depend largely upon the kind of merchant marine policy we adopt, as ships can only be sold to those who desire to employ them in remunerative trade. If it is worth while for the United States to expend nearly $4,000,000,000 (£820,000,000) to build a merchant marine in time of war, it is worth something to build one in time of peace, and it is thought by competent observers that $100,000,000 (£20,500,000) spent before the war would possibly have saved $1,000,000,000 (£205,000,000) during the war.

Another possibility in the future of American shipbuilding, which just now is receiving little consideration from the Government, was emphasized by James A. Farrell, president of the United States Steel Corporation and chairman of the National Foreign Trade Council, who stated that our shipyards will soon overcome our domestic and naval requirements, and when these are realized and maintained we should build for the world's markets. American ships were once among the largest of our exports, and, according to Mr. Farrell, there is no reason why they should not be so again. While all shipbuilders may not share Mr. Farrell's optimism in the belief that because we can sell locomotives, freight cars, agricultural machinery and other products of the mechanic arts to all the markets of the world we shall be equally successful in the export of steamships; nevertheless, the amount of tonnage booked by American shipbuilders for foreign account during the early months of the war should not be forgotten, and if the market for vessel tonnage is such that American yards can compete for such business, this advantage should not be denied them.

LETTER TO THE EDITOR

We Have a Standard Type of Ship—Let Us Have a Standard for Building Ships

The hull foreman is the highest officer representing the hull department in charge of a single ship. It is his duty to direct and co-ordinate the work of the several crafts who achieve the results of a completed ship, not, of course, including the machinery. He should be tactful in the handling of men, as well as quick in the determination of the thousand and one problems requiring his decision daily.

He should be competent to analyze the ship and able to visualize the ultimate intended result; to picture in the mind's eye the vital features of the ship stripped of all detail. He is then, and not before, in a position to build. He should be active physically and mentally; physically, because of the need of constant patrol of the ship from bow to stern, from keel to decks, so that he may see and know every detail of the work as it progresses. Woe unto the hull foreman who does not so patrol, for there is scarcely a job but requires just a bit of advice as to its accomplishment. If some job goes wrong, the hull foreman is the man to blame, for he is the all-wise.

The hull foreman may judge his standing with his superiors by the degree of latitude allowed him in the planning of his work. If he be permitted to plan, his standing of importance is high; if he be allowed no initiative in planning, his standing is nil. This rule is an infallible standard in determining the very important question of standing.

The right of the hull foreman to plan the work is of greater importance than merely to gage his standing with his superiors, for it is this right to plan that makes the job worth having, life worth living—that takes into account the human element, the driving quality of pride derived from knowledge of creative instinct, the impulse to a good job well done.

The matter of standardizing the building of ships in the several yards has been given an impetus because of the building of standard ships. This has given opportunity for men inclined to fads and fancies to invent all kinds of schemes and devices for their building. The enthusiasm of a man who has been bitten with the bug of standardization often leads him to great lengths under the "*standard* of standardization" and the so-called standard quickly deteriorates into a mere set of detailed rules which are fastened on the back of the unfortunate hull foreman as was the legendary "Old Man of the Sea" on the back of the unfortunate castaway.

The distinction between a standard for building ships and a set of rules for building ships is of importance only as it affects results; and results are important, since they determine the success or failure of a shipbuilding business. A standard for building ships should be a general plan of erection and fairing that might apply to any ship. It should be stated simply and clearly, stripped of all unnecessary verbiage and detail. It could be stated on a very few pages of typewritten matter. Having determined the standard, it should be adhered to by all hull foremen.

As distinguished from a standard, there is the faddist's set of rules, which are always ironclad, and in their detail usually impossible of performance.

The view of a man of this type is usually limited by the sheets of paper which contain his so-called standard. The building of ships is something more than a diversion. It is essentially a business representing a financial invest-

ment. The faddist, however, will brook no interference with his foible by such bourgeois matters as business. His only financial interest pertains to salary.

The cost of storing and providing material to permit the building of ships by rule would be enormous, and, indeed, would often be impossible of performance without causing vexatious and expensive delay. But building of ships by rule takes no account of these details nor of the human element involved in the matter of delay. Men delayed in their work are willing to have the condition of delay continued indefinitely. The spirit and habit of work once destroyed are lost.

Let's establish a standard for building ships!

Chester, Pa. WILLIAM F. DELEHANTY.

Prices Yesterday, To-Day and To-Morrow

BY O. P. AUSTIN*

For business, big or little, to prosper or even keep in step with the rapidly changing conditions in the financial world, there must be a clear understanding of the causes which influence the rise and fall of prices. At an industrial conference of the Editorial Conference of the New York Business Publishers' Association, held in New York on April 11, Mr. Austin, the foremost statistician in financial affairs in the United States, if not in the world, clearly analyzed the conditions during the war which caused the world-wide advance in prices. A brief summary of this address is given below, and from this it will be seen that the outlook for a marked or rapid decline in prices, which has been anticipated by many with the ending of the war, does not seem encouraging, at least in the near future.—THE EDITOR.

THE chief causes of the world advance in prices appear to be, in the opinion of the speaker, the inflation of world currency, coupled with the "scarcity demand" and the consequent advance in labor costs. The prospect of material reductions in the near future would depend upon the possibility of the removal or modification of the chief causes of the advance.

Chief Causes of Advance in Prices

Stated chronologically, the chief causes of the advance seem to have been, first, the "scarcity demand" for war materials, food, clothing, manufactures, manufacturing materials and the labor required for their prompt production, but this was quickly followed by an enormous world inflation, in which paper money with a face value of $36,000,000,000 (£7,380,000,000) was emitted by the printing presses of the countries at war, and the legal tender circulating medium of the world was thus advanced from $15,000,000,000 (£3,080,000,000) in 1913 to over $45,000,000,000 (£9,230,000,000) in 1918, most of the gold formerly in circulation passing into the vaults of the governments and their great banks as a partial basis for this greatly enlarged paper currency.

Enormous Inflation in Four Years

The face value of the paper currency issued in the four years of the war was greater than the value of all the gold and all the silver mined in all the world since the discovery of America. Meantime, the national debts of the world have advanced from $40,000,000,000 (£8,200,000,000) in 1913 to $220,000,000,000 (£45,100,000,000) in 1919, and the annual interest charge from $1,750,000,000 (£359,000,000) to $10,500,000,000 (£2,150,000,000); and this quintupling of governmental promises to pay had also an important bearing upon the world finances, while the fact that bank deposits in the fifteen principal countries of the world grew from about $25,000,000,000 (£5,125,000,000) in 1913 to approximately $73,000,000,000 (£15,000,000,000) in 1919 still further increased the currency supply, especially in countries like the United States, in which the check plays so important a part in current business transactions.

This enormous inflation thus brought about, coupled with the continued "scarcity demand" for food, manufactures, manufacturing material, and labor required for their production, was accompanied by great advances in prices—first in the materials for the war, the advances gradually extending to other articles which their respective producers must exchange for those in which the advance had already occurred, and this made the advance in prices world-wide and applying to all classes of articles, irrespective of their immediate relation to the requirements of the war.

Probable Trend of Future Prices

The chief question involved in a consideration of the future of prices is whether there is a prospect of an early removal of the causes of the advance.

The "scarcity demand" still continues in everything except war supplies, and even in that line is not entirely ended, since there are about 15,000,000 men still under arms. The demand for food is as insistent as ever, owing to the disordered state of the population of Central Europe and the impoverished condition of the neglected soils of all that continent, while the factories and empty shelves of all the world are clamoring for new supplies which ran low during the war period.

Early Reduction in Prices Unlikely

As to a material reduction in the inflated currency, the prospects for the near future do not seem encouraging in view of the fact that the 1919-20 "budgets" of the principal countries of the world now being made up call for fully four times as much money as those of the year preceding the war, suggesting that the governmental demands in the first peace year after the war will be about $50,000,000,000 (£10,250,000,000), as against about $12,000,000,000 (£2,460,000,000) in 1913, and that the governments which must quadruple their demands upon their taxpayers and prepare for a reduction of their debts will hesitate about reducing the amount of money in circulation.

While there may be a slight downward trend in the general price level and distinct reductions in certain articles, the difficulty in removing the chief causes of the advance suggests that the general reduction in prices in the near future may not be as rapid as had been anticipated.

* Statistician of the National City Bank of New York.

Problems Confronting American Shipyards*

Analysis of Conditions in the Shipyards—Reasons for the High Cost of Ship Construction—Removal of Existing Inefficiencies Suggested as a Remedy

BY HOLDEN A. EVANS†

THE shipbuilding industry of this country is in a peculiar condition. Before the war we had little oversea merchant shipbuilding. The war brought urgent demand for merchant ships. Large plants were built, both by the Government and private enterprise, and thousands of unskilled men were employed in these plants. To-day this country has greater shipbuilding facilities than any other country. These facilities are largely manned by untrained and half-trained men. The problem before the shipbuilders, therefore, is—what is to be done with these great plants and the army of workmen employed therein?

This must be answered by the Government and the people of this country. At present all of these plants are engaged on Government work. The Government has canceled many contracts and suspended others. The shipbuilder is forbidden to take foreign contracts. The American shipowner will not place any orders. If these shipbuilding plants are to continue in operation, they must be given work by governmental agencies.

Shipbuilding Costs Here and in Great Britain

Before the war cargo ships were built in Great Britain at from $30 to $40 (6/5/0 to 8/6/8) per deadweight ton. At the same time, some cargo ships of similar type were built in this country at from $60 to $70 (12/10/0 to 14/11/8) per deadweight ton. But the American shipbuilder made no money at these prices. The American shipyards were either bankrupt or on the verge of bankruptcy.

To-day contracts are being placed in Great Britain at $100 to $120 (20/16/8 to 25/0/0) per deadweight ton. In this country, under present conditions, it will cost the shipbuilder from $170 to $180 (35/8/4 to 37/10/0) a ton to build the same ship. This is not a pleasant prospect either for the shipbuilder or for the country.

Causes of High Cost of Ships in the United States

The high cost of construction in this country is due to the following:

(1) *High cost of wages.* The wages to-day are double what they were before the war. The wage schedule which was fixed by orders of the Government is approximately double the rates paid in Great Britain.

(2) *The high cost of material.* Before the war steel plates could be bought at $1.10 (4/7), while lately they were $3.25 (13/6½)—approximately three times as much as before the war. All other material costs have greatly increased.

(3) *The inefficiency of a large number of unskilled men taken in the yards,* due to the enormous plant expansion.

(4) *Inefficiency due to rush war methods.* On account of the urgent military need of ships, speed of construction was the only thought. This brought about extravagant methods. One of the results of these rush methods is that the old trained men are not as efficient to-day as they were before the war. It will take some time to bring them back to normal efficient methods.

(5) *The inefficiency due to the rapid increase in wages.* The men do not work as steadily as before the war. There is much more lost time.

This statement of facts will not be disputed by any experienced shipyard manager. What, then, is to be done to continue shipbuilding in this country?

American Shipyard Workers Not the Most Efficient in the World at Present

You will be told by some that the American workman is the most efficient in the world and that this is the answer. The American workman in some trades is the most efficient, but this is not true at the present time in shipbuilding. Ask Homer Ferguson of Newport News, Joe Powell of Bethlehem, Harry Mull of Cramps, Joe Tynan of the Union Iron Works, or any other experienced shipbuilder. They will tell you that shipbuilding is a trade difficult to master. They will tell you that the majority of their skilled men gained their skill and experience in shipyards abroad, and, furthermore, that the shipyards to-day are filled with men who are just beginning to learn.

What, then, is the real answer? It is probable that wages abroad will rise, and that the difference between our wages and theirs will not be so great as it is at present. The cost of material will surely fall, and it seems as if in the near future our material for shipbuilding will be as low as it is abroad. The real answer is: *Remove the various inefficiencies that exist at present and educate and train the workmen.*

Inefficiency Must Be Eliminated

There is no trade or profession which an American cannot master if given opportunity and time. But you can't expect us to learn shipbuilding in a few months in which we have been engaged in the work on a large scale. You can't expect us to compete with managers and workmen who have had years of experience while we have only had our first lesson. It is probable that in the operation of ships on a large scale similar conditions will be found. American operators must be given time to learn before they can be expected to compete with those who have had years' and years' experience.

Shipyards Must Have Ships to Build

We in the shipyards must have work to do—that is, ships to build—and we must have time in which to educate our staff, our foremen and our workmen if you expect us to compete with the world. If we are to maintain a great American-built, American-operated merchant marine, the American people must in some way or another pay for the excess cost while we are learning to build and learning to operate. In no other way will we ever get it.

The American people are thoroughly convinced of the absolute necessity for our own merchant marine, and we are going to have it. But the facts must be learned and the case presented fairly and squarely to the people. They will be willing to pay the price, provided it is a fair price.

But don't be misled, don't make any mistake—the price must be paid if we are really going to get a great mer-

* From an address delivered at the National Marine League dinner, Hotel Commodore, New York, March 27.

† President. The Baltimore Dry Docks & Ship Building Company, Baltimore, Md.

chant marine. We have plants and machinery superior to the equipment abroad; we have aggressive and efficient shipyard managers; we have ingenious and intelligent workmen. What a magnificent foundation! But we must have more than the foundation; we must build on this foundation. Just as in golf—just as in any business or profession—you must have practice if you are to compete —if you are to excel.

So it is in shipbuilding. Give the shipyards and the American workmen in those shipyards a chance—a fair trial. Give the well-equipped plants ships to build, allowing a fair margin of profit. Let our managers and workmen have an opportunity to learn and progress. If you will do this, the extra cost will be well expended—I promise you that—the shipbuilding industry will nobly respond, and in a few years the United States will be the greatest and most efficient shipbuilding country of the world.

Problems of the American Merchant Marine

BY LAWRENCE B. CHAPMAN

To establish the American merchant marine upon a permanent basis, it is necessary to take advantage of the possibilities for American ships to compete with those of other nations. In this article the author, who is a trained naval architect with experience both in the education and training of naval architects and in the practice of naval architecture, summarizes the possibility of the future of the American merchant marine in one word—efficiency. The discussion of the subject shows how material advances can be made in the competitive race for supremacy by efficiency in design, efficiency in construction and efficiency in the operation of ships. When it is realized that both the shipbuilding and shipping industries in America are in their infancy, it is apparent that their development must be carried out along sane lines if their future is to be assured. No one will dispute the author's statement that the possibilities for improvement by efficient designing, construction and operation of ships are prodigious and that herein, other things being equal, lies our opportunity. At a time when established methods and practices must be abandoned to make way for new, there is no better slogan to adopt than the watchword proposed by the author—efficiency.—The Editor.

One hears so much at the present time about the probabilities and feasibilities of the American merchant marine that it is worth while to analyze the situation and see what the possibilities are for American ships to compete with those of other nations. We realize that building costs are higher here than abroad, that the American seaman is paid higher wages, and that as a nation we are not as well educated in shipping as many of the competing nations. But do these facts in themselves rule us out of competition and leave America's only hope for a merchant marine in government ownership?

Future of American Merchant Marine Lies in Efficiency

America's hope lies not in government ownership or ship subsidy, but in efficiency—efficiency in design, efficiency in construction and efficiency in operation. It may be that in the end a government subsidy in some form may be needed; but let this be a secondary or temporary help, not the main support as too many are wont to advocate.

The possibilities for improvement by efficient designing, construction and operation are prodigious; and herein lies our opportunity. The problem of ship design is perhaps the most important of the three, for construction and operation depend to a considerable degree on the design. In the past the design has too often been merely a technical problem of dimensions, deadweight capacity, and power to meet the requirements of the owner. A fair amount of attention has been given in the design to ease and cheapness of construction, but little or no attention to the economics of operation.

Proper Training of Naval Architects the First Need

The first need in this field is that the young men who are to take charge in the future be properly trained and educated. The training of naval architects to meet these new conditions demands a radical change in our university courses. The student's contact with the shipbuilding and shipping industries must begin at the very outset of his training, and the practical, economical and theoretical work must all be carried on at the same time. The requirements of a course of training in naval architecture were treated in an article which I contributed to the April issue of this magazine and need not be taken up in this article.

The shipbuilding yards and steamship companies should make it their duty to assist the students in their studies, by giving them summer work and co-operating with the universities, perhaps offering scholarships or paying part tuition for worthy men in their employ. The establishment of apprentice schools similar to some of the British schools might also be of great benefit.

Scientific Research Should Be Encouraged

Research in naval architecture and marine engineering should be seriously taken up and every possible problem bearing on design, construction and operation threshed out. The British government has recently appointed a committee and appropriated money for this purpose.

Again, in the matter of research, the shipyards and steamship companies should give liberal assistance. It is for them not only an opportunity but also a responsibility. Research professors and students in the universities have the leisure time and the aptitude to investigate many difficult and intricate problems bearing on merchant ship design, construction and operation. That they have in the past given valuable data to the industry, the proceedings of the various technical societies will affirm. Such work as this must be supported by fellowships, scholarships and endowments. The British Government has supported work of this nature in some degree, the recent Bulkhead Committee being an example. Might not our Government contribute to work of this nature as one

of the ways of helping the new American merchant marine?

This research work should be mainly along new and original lines. The fields of model experiments, stability and strength have already been fairly well covered. Experiments with full-sized ships and self-propelled models; investigation of the best form for speed at sea as compared with smooth water; propulsive coefficients; frictional resistance of actual ships; and cargo handling appliances are a few of the problems that suggest themselves.

The naval architect will meet many problems of this nature that his exacting duties will leave little time to solve; yet to keep our merchant fleet at the forefront, these problems must be solved and the method just mentioned offers excellent opportunities. There will be countless problems, especially of an economic nature, that will hold the attention of the naval architect. It will be his duty to keep the building cost as low as possible, to distribute the material to get the maximum strength on the minimum steel weight, to keep the cubic space allowed for deadweight as large as possible, to study the ship as a unit and determine the dimensions, coefficients and speed for the most economical performance in service. The naval architect's duties as a representative of a steamship company will be dwelt upon later in more detail.

Efficiency of Ships in Operation Neglected

As already mentioned, very little attention has been given to the consideration of the design for the most efficient operation in service. The reason for this is because the owners have habitually gone to the shipyards for their designs instead of working them up themselves. The function of the naval architect of the future should be the connecting link between the owner and builder. He should either be on the owner's staff or a consulting naval architect intermediate between the builder and the owner. It should be his duty to adjust the commercial and scientific properties which are often in conflict with one another.

The builder in working up a design to meet stated conditions of the owner has given his main attention to costs, hull and machinery details and construction, ignoring too often the fact that the ship is a unit which has to meet certain economic conditions. This is but natural, for his interests lie in these fields and the owner has not forced the other problem on his attention; if he had, it is doubtful if the builder would have had the necessary experience and data at his command. For this reason the steamship company should prepare its own designs and submit them to the builders. The larger companies could have their own designing staffs, while the smaller companies need only have a retained or consulting naval architect to care for their interests.

Ships Should Be Designed By Owners' Naval Architect

The steamship companies' naval architects should make a thorough study and analysis of the problem in hand and determine the proper size, proportions, coefficients, speed, cargo handling arrangements for maximum efficiency; and propelling machinery and propeller revolutions per minute, etc., for the required service. He will have all the experience, operating data and costs of the steamship company at his command; he can observe the performance of the ships in service, study the loading and discharging problems, make careful observations of the ships while docking and repairing, and have a thorough first-hand knowledge of the operation and economy of the propelling machinery and auxiliaries of the ships of the company's fleet. The design prepared by a naval architect with this information to guide him will fulfill much better the owner's needs and produce the proper ship to give the most economical performance in service. An excellent paper by John Anderson before the Institution of Naval Architects, 1918, touches on some of the economical aspects of this problem.

A ship designed in this way will be planned for the best performance and minimum power in service, not for the builders' trials in smooth water. The owner's naval architect can settle the horsepower, revolutions per minute and propeller dimensions for the speed required, and the builder need only guarantee boiler performance and the horsepower and steam consumption of his engines.

Details Left to the Builder

Many of the details of construction, fittings, equipment, etc., can be left to the builder, or determined by consultation between the builder and owner's representative. With this arrangement the building yards would be relieved of a large part of the expense of working up designs—work which is duplicated for every proposal by nearly every yard in the country. They would be relieved of exacting speed trials and guarantees, all of which add to the cost of the ship. In short, the steamship company would work up the design and submit it to the builders instead of ten or twelve yards each working up their own design and submitting it to the owner.

The propelling machinery with its auxiliaries should receive as much attention as that given to the hull. The owner's naval architect should determine the type of machinery, boilers and desired fuel and steam consumption from his knowledge of the ships in service. Here, again, the machinery will be chosen and designed for service at sea and not for a trial course. The owners should carefully consider whether coal or fuel oil should be used, whether steam or Diesel engines, whether Scotch or water-tube boilers, and whether geared turbines, electric drive or reciprocating engines should be installed. Each of these items must be carefully considered, and saving in space and weight must be balanced against cost and fuel economy. The details of the propelling machinery should be left entirely to the shipyard or engine works.

Saving of Heat Units the Watchword in Laying-Out Machinery

The saving of every possible British thermal unit should be the watchword in the layout of the machinery. A careful and searching study must be given to economizers, feed heaters, superheaters, high steam pressures and high vacua. Economy in British thermal units must be balanced against first cost and depreciation. Each piece of auxiliary machinery should receive its share of attention. Exacting guarantees should not be required for steam consumption of auxiliaries, as this increases the first cost. The exhaust steam is generally used for feed heating, and any economical, and hence expensive, auxiliary is apt to be a loss rather than a gain. Keep in mind that guarantees and rigid inspection increase the cost of auxiliaries. Piping layouts should be simplified as much as possible and all fittings and valves standardized. The owners will have a large experience to draw on for operating costs, economy and repairs of propelling machinery, and the builder will have a wide knowledge of details, initial costs and engineering practice at his command. A complete getting together of the two interests should reduce the costs both of construction and operation.

Guarantees

Another point worthy of discussion is the question of guarantees. In the above arrangement where the ship-

builder assumes practically no guarantee except workmanship, power, and steam and fuel consumptions of main engines, it is not so much importance. There will always be cases, however, where the shipbuilding company assumes the whole responsibility for the finished boat and guarantees speed, coal consumption, G. M., cruising radius, turning circle, etc. In all cases, as previously pointed out, guarantees of any nature increase the initial cost, for the builder must protect himself against the failure to meet these guarantees.

It has been the practice of some firms in the past to exceed their guarantees, especially speed, by a considerable margin and then to acclaim the deed as a remarkably fine piece of engineering. To exceed a guarantee by any but a comfortable margin is as bad engineering, perhaps even worse, as to fall down on a guarantee. Let us consider an example: Suppose a firm contracts for a ship to make 15 knots, and on trial a speed of 16 knots is attained. This is an excess of 6⅔ percent in speed, but an excess of 20 to 25 percent in power. Either the prospective owner is paying for this additional power in a high initial cost or the shipbuilding company is paying for it out of its profits. Unless the ship is of an unusual type or the machinery of a new kind, 10 percent margin in power ought be ample. The owner has ordered a 15-knot ship and believes that he is paying for such, and, while 16 knots may be very acceptable, we should not lose sight of the fact that someone must pay for the extra power. Of course, when bonuses are given for additional speed, the case is different; but the practice which has been followed in the past, especially in naval vessels, of showing a speed of several knots better than the guarantee is not good engineering. The same reasoning applies to all other guarantees and contract requirements. A technical staff trained and educated in the proper manner should keep problems of this nature well in hand and reduce the initial cost.

Efficiency in the Shipyards

Let us now turn our attention to the second problem—the shipbuilding industry. Anyone at all familiar with shipyards the world over must realize the great inefficiency existing. It is with diffidence that I add even a few remarks on this subject. The task of improving conditions is at once so hopeless and yet so rich in possibilities on paper that I am tempted, however, to add a few remarks. If conditions in our yards can be improved and the first cost reduced, serious attention should be given to a study of the problems involved. A shipyard, with shops and building slips covering acres of ground, offers a far different problem than a shop all under one roof, or even a plant such as the Winchester Arms Company, which covers a whole city block. In the former case different types of ships are constantly building, while in the latter practically all processes are along standardized lines. Yet a system of scientific management following more nearly the Taylor system would be a great improvement over many of those existing. Much of the work done in the shops could follow Taylor's system very closely. A route chart of the yard could be made as in the Taylor system and careful study made of routing material to shops and ships. An efficient messenger and information service with 15 or 30 minutes' service might be installed to advantage.

An exact system of scientific management is almost impossible to install on hulls under construction on account of the nature of the work. Some electric system, however, might be devised for calling and keeping in touch with the foremen which would save needless chasing around the yard. Some automatic system that will give the office a continuous check on a ship might also be devised. As an example, frequently a number of fitters are held upon a piece of work because a driller cannot be found. This is but an example; there are countless others like it that the above system would eradicate.

The problem of soldiering and loafing of labor and the needless walking around of the workingmen needs the most serious attention. Better and closer supervision would solve this, but this increases the overhead, which has already gone too far. Overhead, clerks and inspectors must be cut down. There is too much tendency already of paying one man to watch another. The workman must assume more responsibility and report on his own work. Some electric system of keeping a continuous record of the work would solve this problem and save much useless walking to and fro. In a word, the present spirit that pervades the yards must be in some manner extirpated—how, I will not attempt to suggest.

Standardization

Standardization must be introduced—not necessarily standardization of all ships, but the building of ships in groups so that production methods can be used. When ships are built thus in groups, models can often be used and much unnecessary time saved walking to and from shops, climbing aboard ships, etc. Parts, fittings and equipment must be standardized and many times purchased outside the yard. Anything that will save drawing, patterns, casting, forging and clerical work with all its entailed overhead must be eliminated as far as possible.

Anti-fatigue surveys might be made and every possible help given to relieve unnecessary strain on the workmen. F. B. Gilbreth has given a careful study of fatigue problems and has in many instances increased production to a marked degree by relieving the strains of fatigue.

Motion study with a moving picture camera such as Mr. Gilbreth has used will almost always result in an increase in production. This need not be used necessarily with the object of setting the time for a job as in the Taylor system, but more especially to cut down unnecessary motions, etc.

The co-operation of the workman should be sought after and some sort of suggestion system with suggestion boxes installed and prizes or other rewards given for all suggestions adopted. Truly the problem is prodigious, but the reduction in cost of production offers one of our greatest opportunities for building up a merchant marine.

Ship Operation

The problems of shipping and ship operation are even more important than the two just discussed—designing and building. I have already pointed out some of the aspects of operation and the necessity of the owner's naval architect studying these problems. An analysis of this problem by dividing the costs of operation into several groups will be of great benefit. Anderson in his paper before the Institution of Naval Architects in 1918 has given some interesting pre-war costs of operating British ships. For a lack of reliable data on American ships I will use his figures as a basis for discussion.

The first factor on which we should direct our attention is the wages and provisions for the crew. We hear so much talk and there are so many articles in the press regarding the high operating costs of American ships due to the LaFollette Seaman's Act that it will be worth while to clear up this point at the start. The amount expended for wages and food for the crew varies from 7½ to 13½ percent of the operating cost of the ship. If we assume that our expenses are double those of the British—certainly a maximum figure—this item of wages and

provisions averages about 18 percent of the total operating expense. Surely the American public is arguing along wrong lines when they concede that an item which is of an order of 10 to 18 percent of the operating expenses is the prohibitory factor of our merchant marine. Granted that we must accept a higher rate for wages and provisions for crew, there still exists the possibility of shaving down the remaining 80 to 90 percent of the operating expenses.

The following table, made up from data in Anderson's paper, gives the operating expenses for an 11-knot ship with a radius of 4,000 miles. The figures given in the paper show that the ship earns a profit of 20 percent per annum with a freight rate of $2.15 (8/11½) per ton (pre-war conditions).

Length	490 feet
Deadweight	13,126 tons

	Percent
Coal	16.5
Wages and provisions	9.0
Depreciation, insurance and repair	28.0
Brokerage and management	12.5
Loading and discharging	25.0
Tonnage dues	9.5

This table shows a distribution of the operating expenses, and a study of it will show where to begin cutting expenses.

Where Operating Expenses May Be Reduced

Items (3) and (4) are the largest and are more or less beyond our control. Depreciation and insurance have a direct relation to the initial cost, which has been covered earlier in the article. Repairs can ordinarily be kept to a minimum by careful designing and regular inspection.

Item (2)—wages and provisions—is a small item, and, as already stated, will be accepted. If the American scale of wages and standard of food is double that of Britain's, this item becomes 18 percent instead of 9 percent. If our laws require a higher paid and more intelligent crew, can we not expect more efficient handling and better upkeep of the ship than our competitors with poorer paid crews?

Tonnage dues (item 6) are also fixed, but can be kept in hand by attention to tonnage rules when designing. They are of small magnitude, however, and equal for ships of all nations.

Loading and discharging is one of the largest factors in operating expenses. Any reduction in this item, brought about by more expedient and efficient handling of the cargo, not only reduces the large cost of operation (25 percent of total operating expenses) but also allows a quicker "turn around" in port, which means an increased earning capacity for the ship. Under the present conditions a vessel similar to the one under consideration spends about 40 percent of the year in port either loading, discharging or docking.

Loading and Discharging of Vessels Now Costly

Is it not in this field that there is the richest opportunity to cut expenses? Would we not do well to bend all our energies to a study of loading and discharging of cargo to reduce this high percentage of expenses and reduce the time of detention in port? Let us equip the storage sheds with overhead traveling cranes and the wharves with jibs for loading and unloading. Let us load as much freight as possible directly from the cars to the ship or from ship to cars. If goods are to be custom-inspected, double handling may be necessary; here is another opportunity for the national government to help by giving the matter of custom inspection a thorough study so that freight handling will not be delayed on this account.

The layout of the ship's cargo-handling arrangements—booms, winches and hatches—needs the most careful study. As already pointed out, a naval architect employed by a steamship company will give this problem more careful and intimate attention than a shipbuilding company. This layout forms one of the most essential features of the design, and in the past has been given too little attention.

The remaining item in the table is coal (16 percent). The reduction of this item offers abundant and interesting possibilities. More efficient machinery can be installed, such as geared turbines and electric drive, which, on the one hand, will decrease the steam consumption by giving more ideal conditions for the prime mover and, on the other hand, increase the propeller efficiency by giving lower revolutions per minute.

Possibilities of Saving Fuel

Scotch boilers can be replaced by watertube boilers and hand firing replaced by automatic stokers. Both of these will increase the cargo deadweight carried, the former by lighter boiler weights and the latter by the smaller amount of coal carried due to the less fuel consumption per horsepower (better boiler efficiency). The larger the percent of displacement the boiler weight is, the more gain there is in using watertube boilers.

The objection has often been brought forward, and recently with good cause, that watertube boilers are impractical on merchant ships, because they require a much better trained personnel. In the past months of great stress this has been true. In the future, highly trained firemen should be available and this objection removed. If the much discussed Seaman's Act requires us to pay high wages, why not insist on the best type of men—men capable of handling watertube boilers? As I have already pointed out, there are a great many ways open whereby we can make this Act a help rather than the hindrance that we have tried to believe it.

Superheat and Other Means for Increasing Efficiency

Superheat, higher steam pressures, high vacua, better feed heaters, economizers, preheating of the air to the ash pits—all offer great possibilities for increase in efficiency. These should all be carefully investigated, not only from the point of view of steam engineering but also from the standpoint of cost, operating expense, depreciation, etc.

High vacua have been given careful consideration; but the question of increase in initial steam pressure has not received the attention it deserves. This gain is not merely the increase in initial heat contents, but a decrease in entropy, resulting in a lower heat contents of the steam entering the condenser. Thus the gain is greater than is at first apparent. Where turbines with velocity wheels in the first stage are used the pressure can be quickly reduced to that formerly used in reaction blading.

Power Plant Refinements

An examination of power plants ashore will suggest refinements never introduced on shipboard; yet these refinements have been the means of greatly improving the power plant efficiency. Some of these, as mechanical stokers and economizers, have already been referred to. Recording CO_2 meters, feed water meters, draft gages, recording steam gages, thermometers and records of coal used not only assist the engineering force to do better work but they also spur them on to competition, since they know that all the records are open to the superintending engineer of the steamship company. Often many of these

are not advisable, but as a rule many of them can be adopted with great profit.

Strict attention always should be given to the performance of the plant. Soot removers should be installed, leaky condensers remedied, and all the machinery kept to the highest point of efficiency. Boiler and engine tests should be made from time to time as a check on the performance of the ship. Frequently these can be carried out during regular service runs by students of naval architecture or marine engineering with mutual benefit to owner and student.

Coal Versus Oil

Another point that will present itself early in the study of engineering economics is the problem of coal versus fuel oil. Contrasting coal (hand fired) against fuel oil, the saving in favor of the oil is, roughly, 55 percent—30 percent on account of higher heat contents and 20 percent on account of better boiler efficiency caused by better combustion and smaller excess of air. Expressed in terms of pounds of fuel per horsepower per hour, under the best conditions oil will run about 0.87 pound and coal 1.35 pounds per horsepower hour. If we look further into the problem and compare the cost of coal against fuel oil, we find that the oil costs from two to three times as much as coal (Atlantic coast). Combining this fact with the reduction in fuel consumption, it appears that the cost of operating on oil is nearly double that of coal. There are, however, other factors to be considered. The boiler upkeep and the fireroom force are less with oil than coal; the cost and time of bunkering are greatly reduced for oil, and ashes and ash-handling apparatus are absent with oil-fired boilers.

The important saving, however, is in the reduction in weight of fuel carried and the gain in cargo space. The reduction of 55 percent in fuel consumption means an increase in cargo deadweight or a longer radius on the same amount of fuel. Fuel oil can be carried in the double bottoms and other places unsuitable for coal or cargo and a large amount of cargo space gained. The case of an actual ship should be worked out in order to see just what the gain would be. In the final analysis, when all the above factors are given proper weight, fuel oil will generally be a decided advantage, provided, of course, that the vessel's route is such that oil is available.

Mechanical stokers are in operation to-day that show nearly the same boiler efficiency as oil; so this fact should be given weight in any just comparison and the above difference will be somewhat reduced.

Possibilities of the Diesel Engine

The possibility of Diesel engines needs careful attention and this type of machinery installed where feasible. At present the horsepower available is the real limiting factor in most cases. Engines up to 3,000 horsepower and slightly larger are now available; so this allows at the present day an installation of 6,500 horsepower with twin screws.

The fuel used by Diesel engines (.45 pound per shaft horsepower) is, roughly, one-third to one-quarter that used by a reciprocating engine with hand-fired Scotch boilers. The remarks on fuel oil versus coal given above hold equally well here, except the reduction in fuel consumption and consequent increase in deadweight will be double that of the all-steam comparison. There is also the elimination of the fireroom force with Diesel engines.

Diesel-electric propulsion also offers fine possibilities. This method of drive gives a reduction in propeller revolutions per minute and allows two engines and one propeller, if desired, thus giving a possible 6,500-horsepower on one shaft. Electric deck machinery can also be used.

The study of trade routes and markets are important problems needing earnest attention, but are beyond the scope of this paper.

It would appear from the above analysis that the future of the American merchant marine is more or less in our own hands. To compete successfully with other nations on the seas, many of our established methods and practices must be abandoned, our shipyards must be given a thorough house-cleaning, and efficiency must be the watchword in designing, building and operating. The economies of ship operation—entirely neglected in the past—must be given serious attention in the design, so that the ship will be of the proper size and speed to earn the largest percentage of profit on the smallest initial cost; loading and discharging facilities must be improved to cut down expenses and decrease the ship's detention in port, and the propelling machinery must be brought up to the highest point of efficiency, both in design and operation.

Oil Tanker F. Q. Barstow Repaired in 64 Days

On November 22, 1918, when a disastrous fire swept over the Standard Oil Company's piers at Canton, Baltimore, the company's tanker *F. Q. Barstow* was very badly damaged. This tanker has a gross tonnage of 10,290 tons and is 500 feet long and 68 feet 2 inches beam. At the time of the fire the ship was tied up at the Canton pier, and it was impossible to take her away from the dock until practically the whole interior was wrecked.

Bids were immediately solicited by the Standard Oil Company from the Eastern repair yards. A New York concern agreed to do the work in 155 days, a local Baltimore concern in 130 days, and the Baltimore Dry Docks & Ship Building Company, Baltimore, Md., in 65 days. Contract was placed at once with the latter firm, and the vessel was moved over to the south plant of the company.

On December 9, 1918, the work was started on the *Barstow*. Repairs were absolutely completed on the whole vessel at 4 P. M., February 10, 1919, and the vessel left the plant of the Baltimore Dry Docks at 11:30 on the following day to be provisioned and supplied preparatory to leaving for Tampico and Port Arthur, Tex. The vessel had been at the plant only 64 days, and during this time two holidays intervened on which no work could be done, and eight days were lost on account of inclement weather, so that the work was actually done in 54 working days.

The repair work on the vessel comprised the replacing of 102 damaged shell plates and 126 damaged deck plates, as well as the necessary stringers, brackets and longitudinal and transverse frames. In addition, it was necessary to provide new fittings in the captain's quarters, the officers' quarters forward, the saloon, wireless quarters, the pilot house and forward quarters. New quarters were also constructed for the crew amidships.

Activities of the Steamboat Inspection Service.—During the year 1918 the United States Steamboat Inspection Service inspected and certificated 7,015 vessels, with a total gross tonnage of 8,464,696, of which 6,788 were domestic vessels, with a total gross tonnage of 6,846,356, and 227 were foreign passenger steam vessels, with a total gross tonnage of 1,618,340. Of the domestic vessels, there were 5,532 steam vessels, 695 motor vessels, 18 passenger barges, and 543 sea-going barges. There was an increase of 31 in the total number of vessels inspected, and an increase of 1,215,107 in the total gross tonnage of vessels inspected, as compared with the previous fiscal year.

UNITED STATES BATTLESHIP NEW MEXICO

The First Battleship in the World to Be Equipped With Electrical Propelling Machinery

Fig. 1.—The *New Mexico* is 624 Feet Long Over All, 97 Feet 4½ Inches Extreme Beam, and at a Draft of 30 Feet Displaces 32,000 Tons

Fig. 2.—The *New Mexico* at Anchor in the Hudson River at New York

United States Battleship New Mexico

First Capital Ship in Any Navy to Be Fitted with Electric Drive—Description of Propelling Machinery—Trial Data

BY COMMANDER S. M. ROBINSON, U. S. N.

THE completion of the *New Mexico's* trials marked the successful end of a campaign that was begun more than ten years ago by W. L. R. Emmet, of the General Electric Company. At that time Mr. Emmet, in his advocacy of electric propulsion, was in the position of an apostle with a small following, but in the Bureau of Steam Engineering of the Navy Department he found an organization that was progressive enough to undertake the development of a system that offered such great advantages. He was able, therefore, to secure a contract with the Navy Department for the machinery of the collier *Jupiter,* and thus the experiment of electric propulsion was begun. It was successful from the start, and after a year's trial Rear-Admiral R. S. Griffin, the chief of the Bureau of Steam Engineering, shouldered the responsibility of putting it into capital ships, the *New Mexico* being the first.

Before proceeding to a description of the *New Mexico* and her machinery, the advantages of electric drive will be briefly touched upon. Inasmuch as the machinery plant of every type of ship is a complete problem in itself, the comparison of electric drive and other types of propulsion will be confined to that type of ship for which the United States Navy has adopted it—the capital ship. Owing to the large horsepowers that are used in this type of ship, the choice of a method of propulsion is limited to direct-connected turbines, geared turbines and electric propulsion, so that comparison will be made between these three.

The first of these suffers in all points as compared with the other two, and therefore may be discarded at once, provided either of the other methods is sufficiently reliable to make it satisfactory for naval purposes; therefore, the comparison may be further restricted to geared turbines and electric drive.

Comparison of Electric and Geared Turbine Drive

The comparison between the two types of installation should be made in regard to the following points:

(1) Reliability.
(2) Necessary weight and space.
(3) Steam consumption.
(4) Flexibility as regards installation.

Of course, no type of machinery can be given any consideration which is not absolutely satisfactory in regard to the first point—reliability. It is believed that the experience of the Navy Department with electric propulsion on the *Jupiter* has demonstrated its reliability beyond any reasonable doubt. That ship has been in commission over five years and has been in continuous service with practically no electrical troubles. The trials of the *New Mexico,* just completed, indicate that she should duplicate the *Jupiter* in this respect.

There are several reasons why electric propelling equipment should be more reliable than other types of machinery. The weakest member of electric propelling machinery is in the same place that it is with other types of propulsion—that is to say, in the steam turbine itself. However, owing to the fact that this turbine has no backing turbine incorporated with it and therefore always runs in the same direction, it should be much less liable to damage than those turbines which are directly connected or geared to the propeller shafts. Also, it should be much less liable to damage from mis-alinement. In many cases with direct-connected or geared turbines, the wrecking of one turbine will put two shafts out of commission; with electric machinery this is never the case, as each shaft can be entirely isolated from the others by opening the disconnecting switch of the motor on that shaft. Also, in case of damage to a turbine, with the straight steam drive, the work on the remaining shafts is very much increased owing to the drag of the idle propellers; with the electric drive, failure of a turbine does not in any manner affect the method of propulsion, as all screws will still be in use.

This is quite an important point, not only because of the added resistance of the dragging screw, which may be as high as 15 percent of the total effective horsepower required to drive the ship, but also because the maneuvering qualities of the ship are seriously affected. This is especially true if the damage to the turbine is such that its shaft cannot be allowed to revolve. In this case, the maximum speed of the ship will be very low, as it will not be possible to lock the damaged shaft against high speeds of the ship.

Another less important advantage of the electrically propelled ship is its flexibility of operation, which allows the operating engineer quickly to shift from one turbine to the other. This advantage is brought out most strongly in the case of a ship entering or leaving harbor where one of the main condensers may be temporarily plugged with mud or other foreign matter requiring a temporary shutdown of that turbine.

Weight and Space

In regard to the second point—the question of weight and space—there is little to choose between the electric drive and the geared drive, but both are very superior to the direct-connected turbine in this respect. In the case of the *New Mexico,* there was a saving of over 200 tons in machinery weights as compared with her sister ships, which were equipped with direct-drive turbines and geared cruising turbines. It is probable that the geared drive has some advantage over the electric drive in this respect, but the difference is not great enough to be of much importance.

In regard to the third point, or the steam economy, the geared drive will probably have a maximum of 5 percent advantage at full power over the electric drive. As the speed is lowered, this advantage very quickly disappears and at most of the operating speeds of the ship the electric drive will be better in this respect. At the cruising speeds of 15 knots and below, the advantage of the electric drive in this respect will be very marked indeed. Of course, this advantage of electric drive at the lower speeds can be offset by installing a separate set of geared turbines for cruising purposes, but in this case any advantage of the geared drive as regards weight will then disappear and the operation of the machinery will become very much more complicated.

Flexibility of Installation

In discussing the fourth point—installation—I will touch upon the main and compelling reason for the adoption of electric drive for capital ships. The advantages in this respect are so great that they cannot be ignored. Any prime mover which must be attached to the propelling shaft, as is the case with any type of machinery except electrical, is at an enormous disadvantage in this respect. The main turbo-generators for electric propulsion may be placed in any part of the ship that is most suited for the purpose. They may be placed in compartments forward of each other on the center line; they may be placed at any desired height above the base line; and, in fact, there is practically no limit to the variety of the arrangement.

The result of this flexibility is that a ship can be designed to give far more adequate protection to the ship and machinery against damage by torpedoes and gunfire than is the case with any other type of machinery. The main motors, which are directly connected to the shafts, are very small compared with a geared turbine, so that the compartments in which they are placed will be very small and will not menace the ship in case they are flooded. These compartments are, of necessity, vulnerable because they must be located outboard. The motors can be placed very much further aft than can steam-driven turbines, and the length of propeller shafting can be very materially reduced, with consequent reduction of liability to derangement of the shaft itself on account of injury to the ship, and also reduction of danger to the ship itself on account of the shafting not having to pierce a number of watertight bulkheads. The most important auxiliaries can be concentrated in the machinery compartments located on the centerline of the ship where they can be best protected, instead of being scattered around the ship in various vulnerable turbine rooms, as in the case of gear-driven installations.

Electric Drive Gives Ideal Arrangement

From an engineering point of view, electric drive gives an ideal arrangement, as it is possible to group the boilers around the engines in such a way as to give the minimum length of steam and other piping, as well as a reduction in the diameter of the pipes and in complication of their arrangement. This is of the greatest importance in the case of the battle cruisers where the problem of getting steam from the boilers to the engines becomes a serious matter, if it is attempted to make the orthodox arrangement of fire rooms and engine rooms with all the boilers forward of the machinery space and all of the steam pipes united before they are brought to the turbines. The maximum size of steam piping, except for a short section at each turbine, is very little greater on the battle cruiser as laid out with electric drive than it was on former battleships, and the total length of main steam piping is not much greater on the battle cruisers than it is on some of the former battleships.

Propelling Machinery of the New Mexico

The *New Mexico* is one of three sister battleships, the other two being the *Mississippi* and the *Idaho.* The first of these is equipped with direct-connected Curtis turbines and the latter with direct-connected Parsons turbines, and both ships have geared cruising turbines. The illustration, Fig. 1, gives a general idea of the size of the *New Mexico.* Her principal dimensions are as follows:

Length overall	624 feet
Length on load waterline	600 feet
Breadth, extreme	97 feet 4½ inches
Draft	30 feet
Displacement	32,000 tons
Designed speed	21 knots

The main propelling machinery of the *New Mexico* consists of two alternating current turbo-generators, four induction motors, two 300-kilowatt direct-current exciters,

two motor generator boosters, main switchboard, exciter switchboard, ventilating blowers for the main motors, and the necessary wire and cable. The weight of the above machinery is approximately 500 tons.

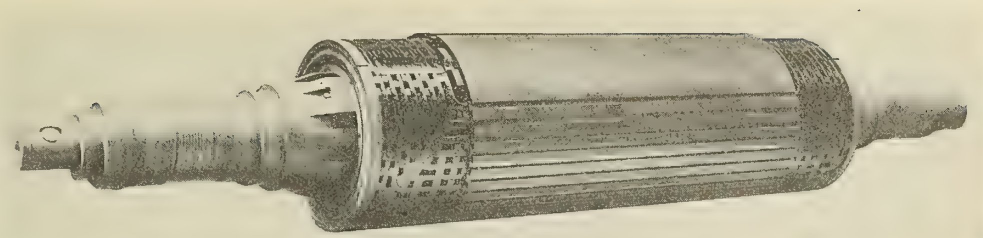
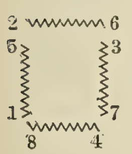


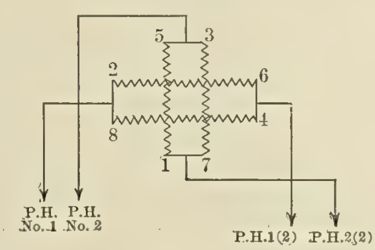
Fig. 5.—Rotor of High-Speed Turbine Generator

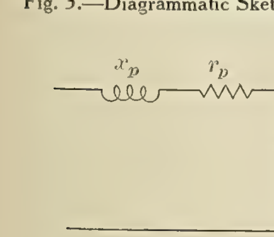
Main Generators

The main generators are two-pole, quarter-phase, having a maximum capacity of about 11,500 kilowatts. Each generator is provided with a disconnecting switch which is double-throw. In one position of this switch the windings of the generator are arranged in the series or square connection, and in the other position of the switch the generator windings are arranged in parallel or diametrical connection. The first position is used when one generator is operating two motors, and under this condition the maximum voltage of the generator will be 4,242 volts. The second condition is when one generator is operating four motors, and under this condition the maximum voltage will be 3,000 volts. This arrangement enables the generator to utilize to the best advantage the doubled current capacity of the motor circuit when using four motors, and improves the overall efficiency of transmission.

The arrangement of windings is shown diagrammatically in Fig. 3. With this exception, the generators differ very little from the ordinary commercial type of alternator, except that special care was taken in the treatment of the stator coils, particularly the projecting end windings, in order to make the insulation moisture proof. The generator field was also designed with a liberal margin in regard to heating, to be able to take care of the overexcited condition that arises when maneuvering. Figs. 5 and 14 show in detail the construction of the generator.







For the 3,000 volts, so-called "Diametrical" connection, windings 2-6 and 8-4 are connected in multiple and 5-1 and 3-7 are connected in multiple so that phases are as follows.

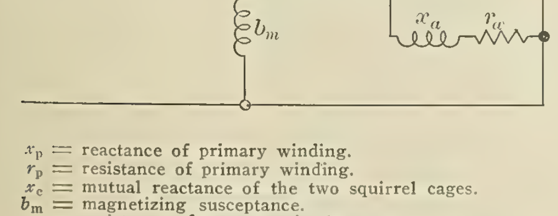
Phase 1 2-6 and 8-4.
Phase 2 5-1 and 3-7.

For the 4,242 volts, so-called "square" connection, windings are connected in series as shown.

2 & 5 6 & 3
8 & 1 7 & 4

So that 2, 5 and 7-4 are phase 1, and 6, 3 and 8-1 are phase 2.

Fig. 3.—Diagrammatic Sketch Showing Arrangement of Windings



x_p = reactance of primary winding.
r_p = resistance of primary winding.
x_c = mutual reactance of the two squirrel cages.
b_m = magnetizing susceptance.
r_b = resistance of upper squirrel cage.
r_a = resistance of lower squirrel cage.
x_a = reactance of the lower squirrel cage, which is not mutual with the upper squirrel cage.

Fig. 4

Turbines

The turbine differs very little in its construction from the ordinary commercial turbine used for driving alternators; there are a few points of difference, however. The casing is divided at the low pressure end by a plane at right angles to the axis, so that it is possible to lift that portion of the casing which covers the blading without disturbing the exhaust connection to the condenser overhead.

The governor differs from the ordinary type of governor in that it has a movable fulcrum which makes it possible quickly to change the speed at which the governor will hold the turbine. All speed changes are accomplished by shifting this fulcrum.

The turbine has two openings in its casing for the admission of exhaust steam from the exciters or the auxiliary exhaust line, and there is an automatic valve in this exhaust line which is operated by the governor-controlling mechanism. When the governor shuts all main steam off the turbine, further movement will open this automatic valve and by-pass the auxiliary exhaust to the main condenser.

The turbine is provided with an overspeed governor which closes the main throttle and also closes automatic trip valves in the lines which supply auxiliary exhaust steam to the fifth and eighth stages of the main turbine, thus shutting off all sources of supply of steam to the main turbine. The control mechanism of the governor is extended to the center engine room by means of bell-cranks and levers. The arrangement of the governor mechanism is shown diagrammatically in Fig. 6. The details of the turbine are shown in Fig. 7.

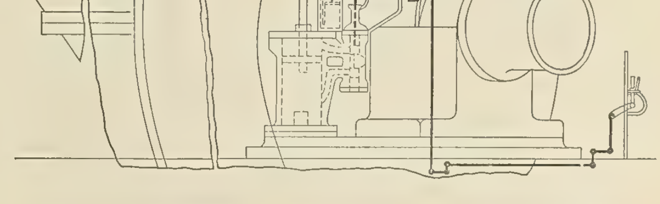


Fig. 6.—Arrangement of Connections of Operating Mechanism

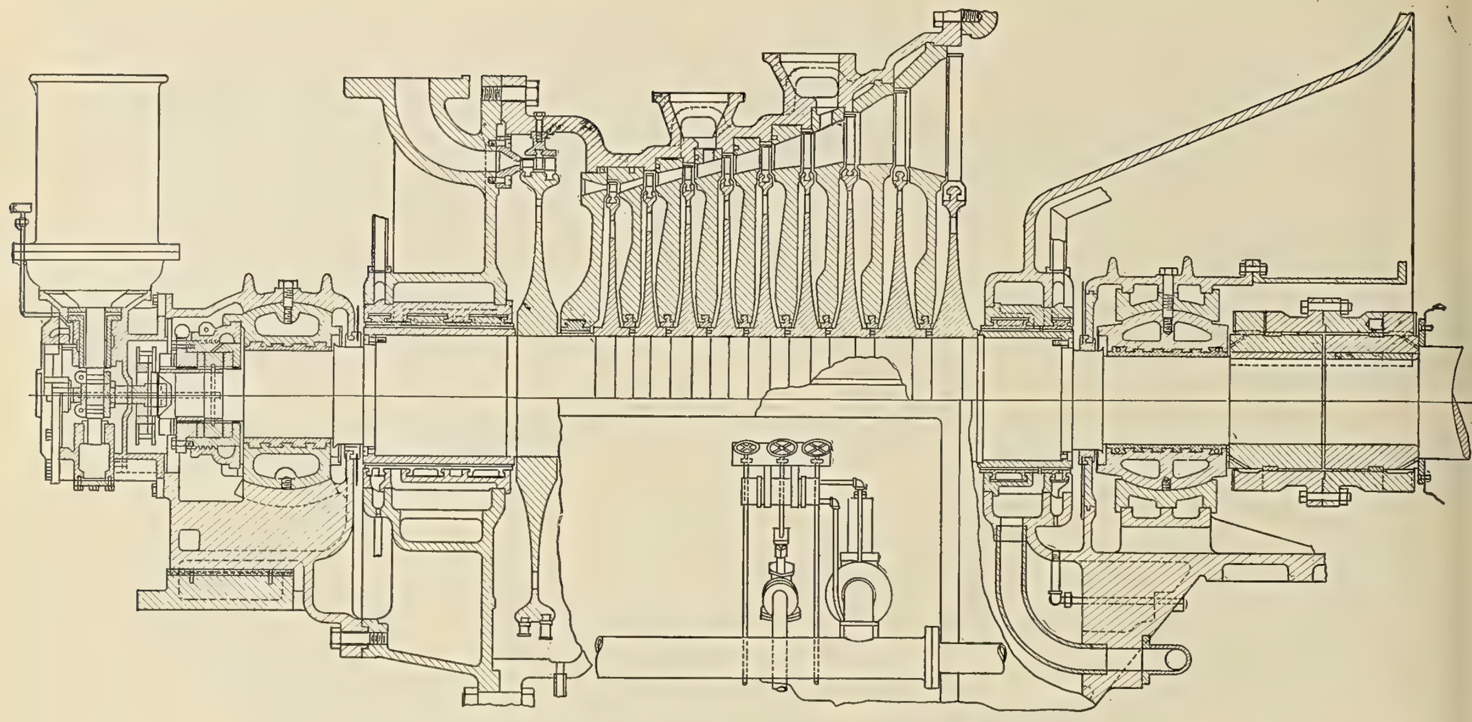


Fig. 7.—Assembly Cross Section of 10-Stage Horizontal Steam Turbine

The main motors are designed to give about 29,000 horsepower at 167 revolutions, which corresponds to a speed of 21 knots of the ship. The motor stator windings are arranged to provide for pole changing and are provided with pole-changing switches which give 24 poles on the stator when in one position and 36 poles when in the other position. The motor stator is provided with only one winding and the pole changing is accomplished by changing the arrangement of this one winding.

Motors

The motors differ more from previous designs than any other part of the machinery. It is believed that these are the first motors of this type constructed, other than experimental ones. They are of the double squirrel cage type with two independent sets of rotor windings in two slots which are separated by a deep air gap of narrow section. The construction of the slot is shown in Fig. 9. The construction of the end windings of the stator and rotor is shown in Figs. 12 and 13.

It will be noted that extreme care has been taken in arranging the short-circuiting rings to provide amply for the very great expansion which takes place in these windings when maneuvering, due to the large rushes of current. The inner squirrel cage, or lower bar in the slot, is of low resistance, while the outer squirrel cage is of high resistance. In operating under normal conditions with the motor running at practically the synchronous speed of the generator, the two squirrel cages act like parallel circuits.

Fig. 4 shows an equivalent circuit of this type of motor. From this figure it will be seen that at low frequencies of the rotor, such as obtain when the motor is running at practically the synchronous speed of the generator, the reactance of the rotor is very small, whereas with large slips, such as obtain when reversing, the reactance is very much greater. The physical explanation of what takes place is that during ordinary running the rotor flux circles both squirrel cages, but when the frequency of the rotor becomes high, the flux is forced across the narrow air gap, practically short-circuiting the inner squirrel cage and thus giving the effect of a squirrel cage of high resistance and providing the necessary torque for reversal.

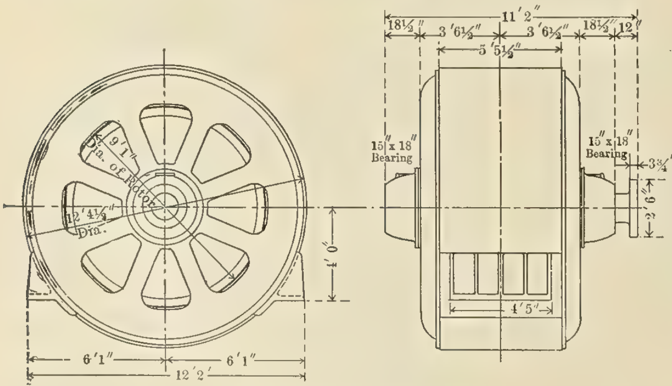


Fig. 8.—Dimensions of Motor

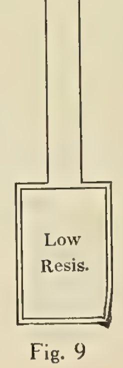


Fig. 9

The torque curve of the motor will be a resultant of the two squirrel cages and the shape of this curve is shown in Fig. 15. It will be seen that the torque required for reversal is very large owing to the peculiar shape of the torque curve of the propeller, which is shown on the same figure. In fact, the shape of the propeller torque curve during reversal is the deciding one in the design of induction motors for this work and makes the problem very much more difficult than would be the case if the torque dropped in a uniform manner all the way down. This figure also shows that it is necessary to slow the turbine down during reversal, otherwise the motor could never pull into synchronism with the generator, as the torque required to drive the motor astern at the same speed as when going ahead is several times the latter.

Control Gear and Switches

The control gear and switches for the propelling equipment are mounted on the main

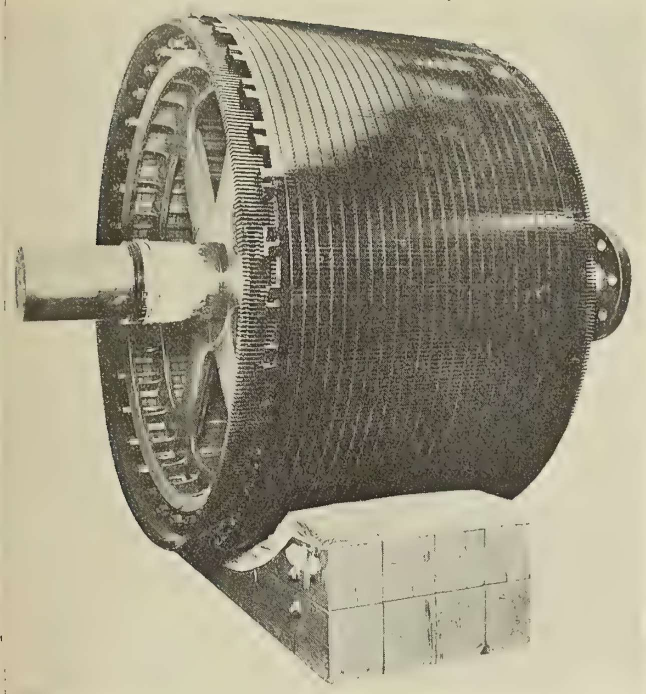


Fig. 10.—Double Squirrel Cage Induction Motor Rotor

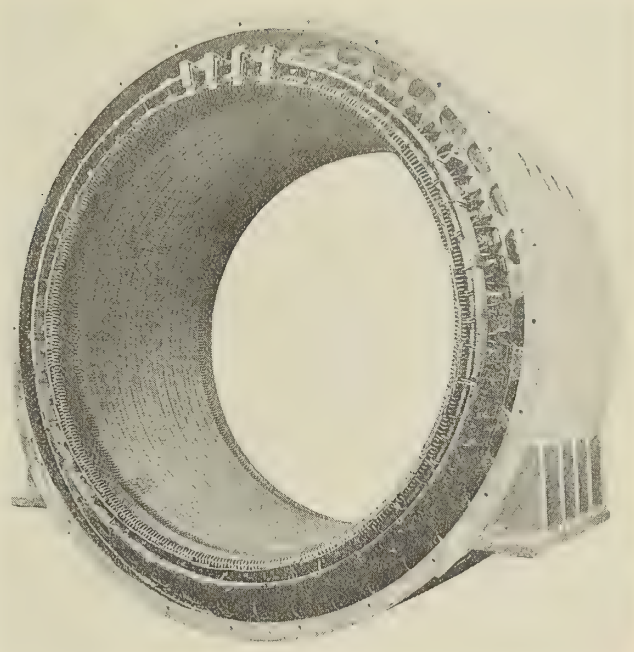


Fig. 11.—Induction Motor Stator Completely Wound
The stator windings are provided with pole-changing switches which give either 24 poles or 36 poles

and exciter switchboards, which are shown in Figs. 16-24. The exciter switchboard contains the main generator field switch and the switches necessary for the various auxiliaries that are motor driven. The rest of the equipment is contained in the main switchboard, except the generator disconnecting switches, which are mounted on the engine room bulkheads, just outboard of the main switchboard on each side of the center engine room.

On the upper part of the switching structure are mounted the motor disconnecting switches, which are of the knife blade type. On the inside of the cell structure is mounted the bus tie switch which connects the two sides of the ship, making it possible to run all four motors from either generator; this is also a knife blade switch. The pole-changing and reversing switches are of the oil type and are mounted inside the cell structure of the board.

The pole-changing switches are of the laminated brush type and the 24-pole and 36-pole switches are mounted in the same oil tank; contact is made on one side for the 24-pole connection and on the other for the 36-pole connection. The same is true of the reversing switches which make contact on one side for the "ahead" direction and on the other for the "astern" direction.

The reversing switches are three-pole, the fourth wire being carried straight through to the motors. It is necessary to open one wire of the second phase when the switch is in the off position, as otherwise the motor would continue to run as a single-phase motor after having been started. Reversal is accomplished by merely crossing the two leads of one of the phases.

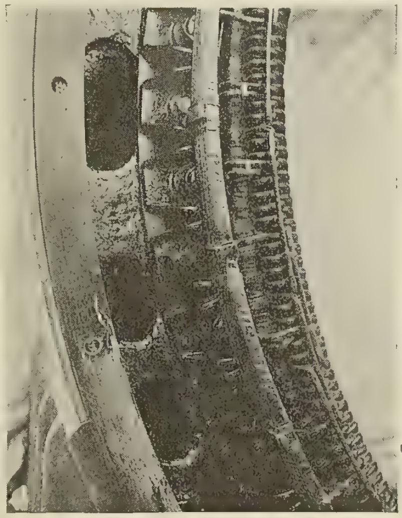


Fig. 12.—Section of Stator Winding

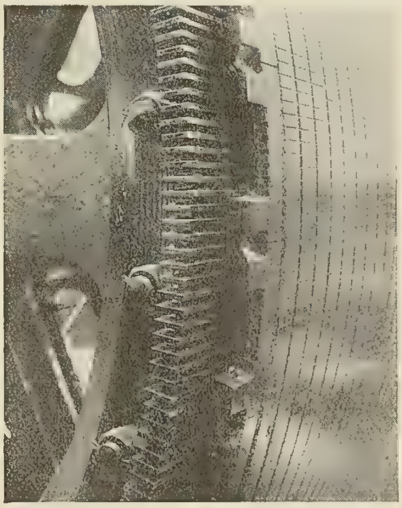


Fig. 13.—Section of Rotor Winding

These switches are clearly shown in the accompanying photographs. Only one lever is used for operating the reversing switches of one pair of motors, and the same is true of the pole-changing switches.

The speed lever is mounted on the front of the switchboard and is connected by rods and bell cranks to the governor mechanism already described and shown in Fig. 6. The steam limit lever is mounted on the switchboard directly underneath the speed lever and connects to the governor mechanism by means of rods and bell cranks.

This steam limit lever, when set at any given position, limits the amount of steam that the turbine can take, by interposing a stop in the way of the governor. This lever is necessary on account of the big change in power that takes place when the ship is turning. The turbine, being at all times under control of a governor, will attempt to run at a constant speed regardless of the power used, and in turning with full rudder at full speed of the ship the power required for this purpose is far in excess of what the generator is capable of giving, so that if a limit were not set on the amount of steam that the turbine can use at any given speed the result would be that the generator would be unable to hold up its voltage when the excess power is thrown on it and the

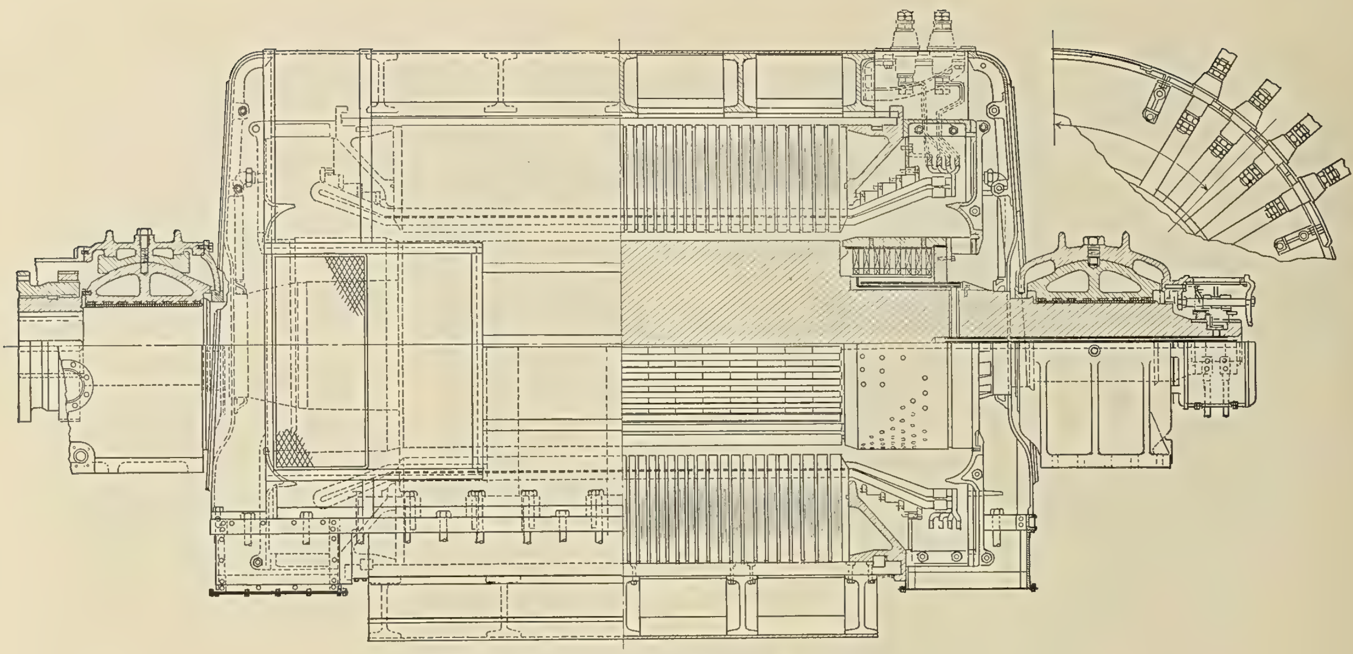


Fig. 14.—Assembly Drawing of Generator

motors would drop out of step. The field lever is mounted alongside the speed lever and operates both the solenoid for closing the main field switch and the rheostat of the booster which controls the strength of the main field. The main field switch is solenoid operated and is mounted on the exciter switchboard.

The Booster

The booster is a motor generator set, the motor end of which is a constant speed motor; the field current for the main generator passes in series through the generator end of the booster. The field lever on the switchboard varies the field of the booster generator and hence its voltage, thus regulating the voltage imposed on the slip rings of the field of the main generator. The field of the booster generator is arranged so that in the mid-position of the field lever it has no field at all; in full throw of the field lever in one direction the generator boosts the 300-kilowatt generator voltage about 60 volts, and in the other position of the field lever it bucks it about 60 volts.

The booster was used for varying the field of the main generator instead of using a generating set for this, because it was desired to have the exciting sets the same size and construction as the ship's power and lighting sets,

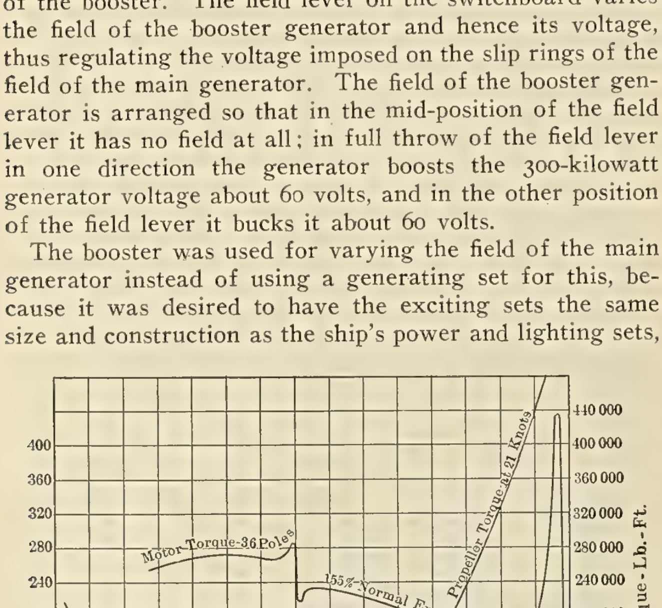


Fig. 15.—Curves Calculated from Following Data at 21 Knots. Total Shaft Horsepower 29,000

which were 300 kilowatts, but the power used for excitation was only about 55 kilowatts, so it was decided to utilize the remainder of the power of the 300-kilowatt sets for running the main engine auxiliaries, and it was, of course, necessary to keep the voltage constant on the 300-kilowatt sets when using them in this way.

General Arrangement of Propelling Machinery

The general arrangement of the propelling machinery and its auxiliaries is shown in Fig. 26. This also gives a diagrammatic arrangement of the alternating-current and direct-current wiring. The main circulating pumps, main condensate pumps, main air pumps, and forced lubrication pumps, are motor driven and are run from the 300-kilowatt exciter sets in the center engine room. The condensate pumps are of the double inlet volute type. The air pumps are of the reciprocating dry vacuum type built by Wheeler Engineering Company. The main circulating pumps are built by the Alberger Company, and the forced lubrication pumps are of the Kinney rotating plunger type. The forced lubrication pumps supply oil for the turbo-generators, motor and thrust bearings, and also for the operation of the main governor hydraulic relay. The ventilating blowers for the main motors are also supplied with power from the exciting sets. The exciter switchboard is supplied with power from the ship's after distribution room, as well as from the exciters in the center engine room, and each of the motor-driven main engine auxiliaries is supplied with power from a double-throw switch which can be thrown to either the exciter bus or the ship's circuit bus, thus giving two sources of supply for current at all times.

Interlocking Devices

The various switches and levers used in the operation of the machinery are provided with interlocks so that it is impossible to do any damage to the machinery through mistakes in operation. The motor disconnecting switches and the generator disconnecting switches are provided with electric locks so they cannot be moved unless the main generator field switch is open, assuring that all circuits are dead. The doors leading to the inside of the main switchboard are also electrically locked in the same man-

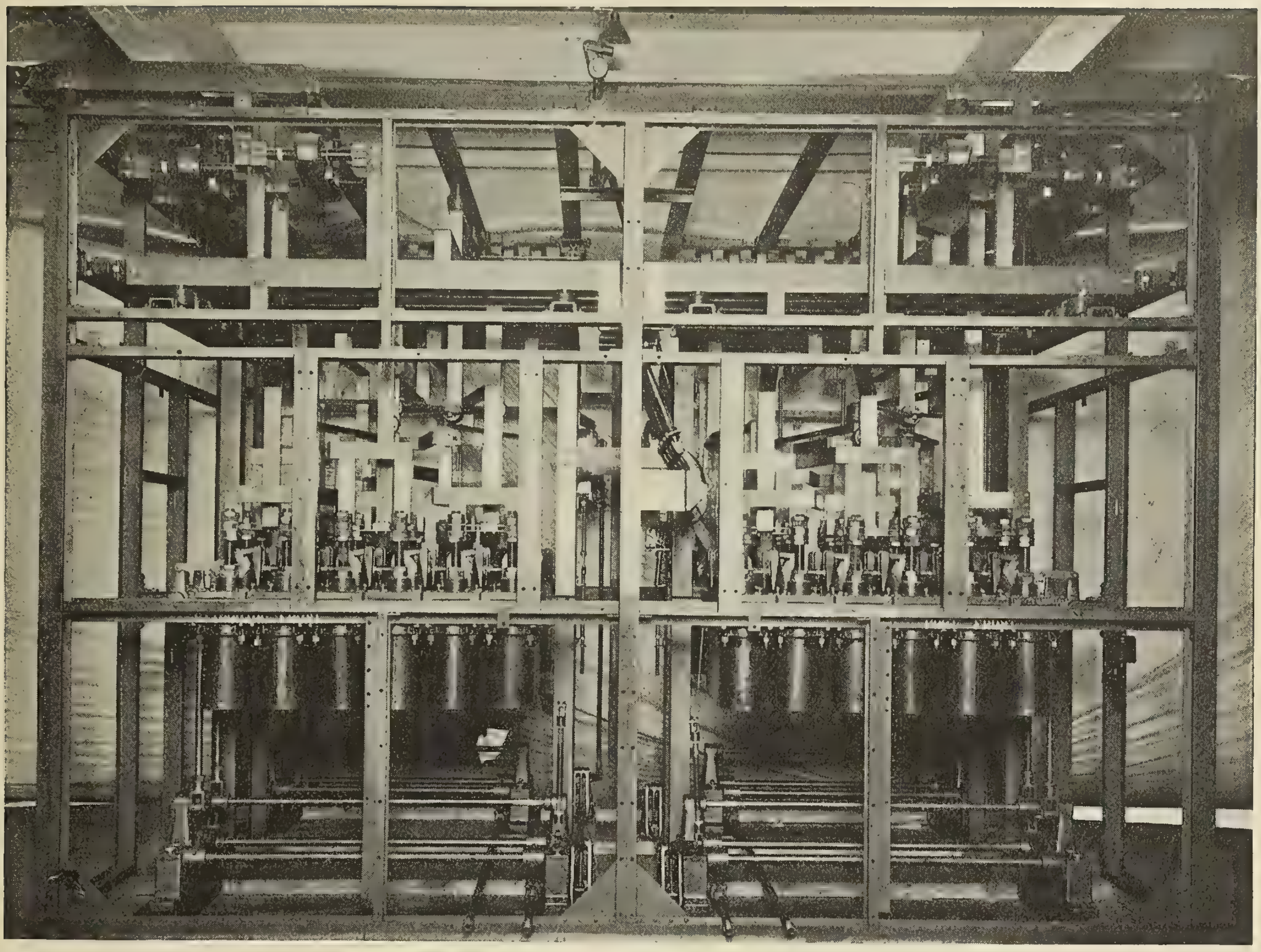


Fig. 16.—Propulsion Control Equipment, Front View, With Panels, etc., Removed

ner. This prevents anyone from getting at the bus tie switch, which is located inside the switching structure, unless all circuits are dead. The bus tie switch and the two generator disconnecting switches are mechanically interlocked so that only two of these switches can be closed at any one time, thus preventing putting the two main generators in parallel. They are also interlocked so that the generator disconnecting switches can be thrown only into the high-voltage position of the generator when the bus tie switch is open, and only into the low-voltage

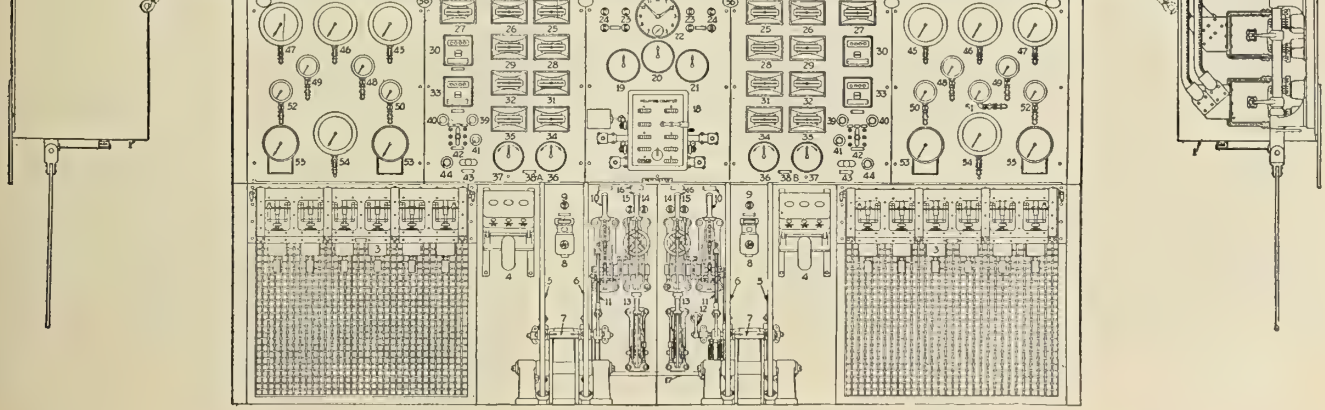


Fig. 17.—Main Operating Switchboard

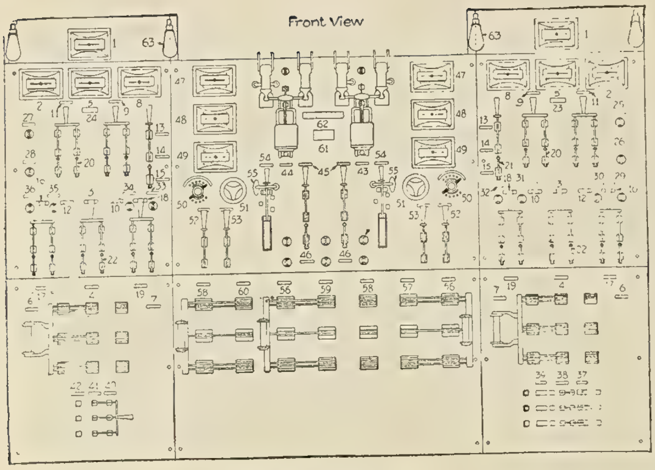


Fig. 18.—Front View

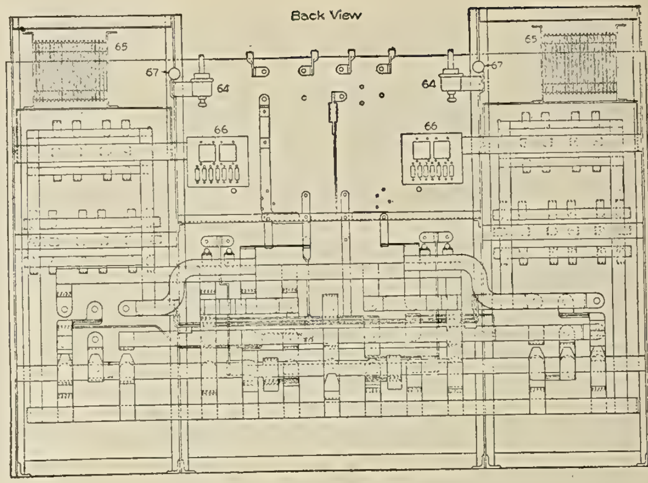


Fig. 19.—Back View

position of the generator when the bus tie switch is closed, thus insuring that the generator will always be run with low voltage when driving four motors and on high voltage when driving only two motors.

The pole-changing and reversing levers are mechanically interlocked with the field levers so that they cannot be moved unless the field lever is in the open position, thus insuring that all circuits are dead. The pole-changing and reversing levers are also electrically locked by an under current relay on the main generator circuit, which prevents these switches from being opened until the current in the main generator circuit has dropped to a predetermined value. This is an additional safeguard on the lock from the field lever, which was added because it was found that the field lever could be operated so rapidly as to make it possible to open pole-changing and reversing levers with large currents still flowing; and, while these switches are built to do this, it makes the operation very much easier on both the generators and the switches to allow a time interval of about three seconds before opening these switches.

The pole changing and reversing levers are mechanically interlocked so that the reversing levers cannot be thrown in the astern position unless the pole changer is in the 36-pole position. This insures that the maximum torque of the motor will be available for reversing, as the maximum torque is greater on the 36-pole condition than on the 24-pole condition.

The field levers and speed levers are mechanically interlocked so that the speed lever is carried to the low speed whenever field is taken off the main generator. Also, any large increase of speed will carry the field lever with it, thus increasing the strength of the main generator field. This arrangement insures that large increases of speed

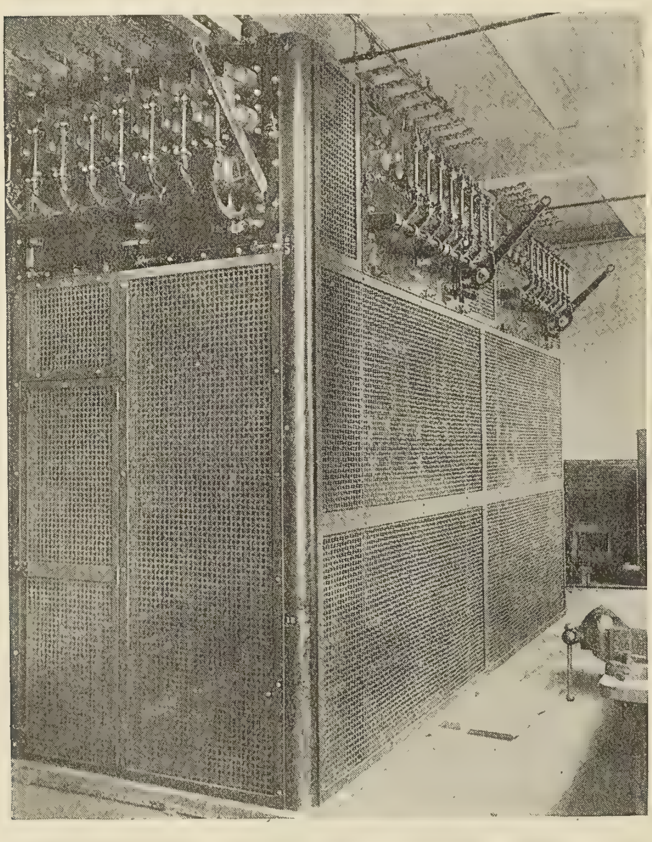


Fig. 20.—Cell for Propulsion Control Equipment; Port and Rear View

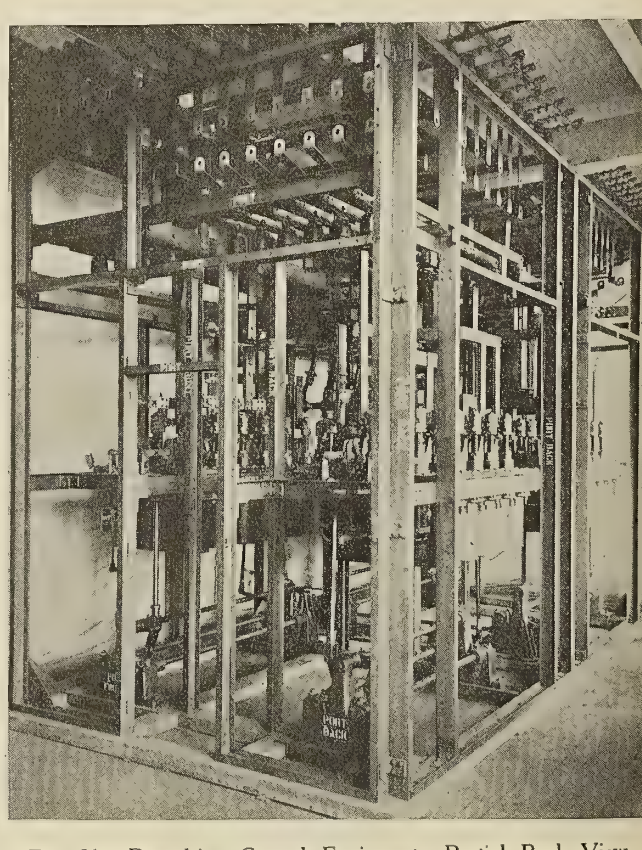


Fig. 21.—Propulsion Control Equipment; Partial Back View With Grille Work Removed

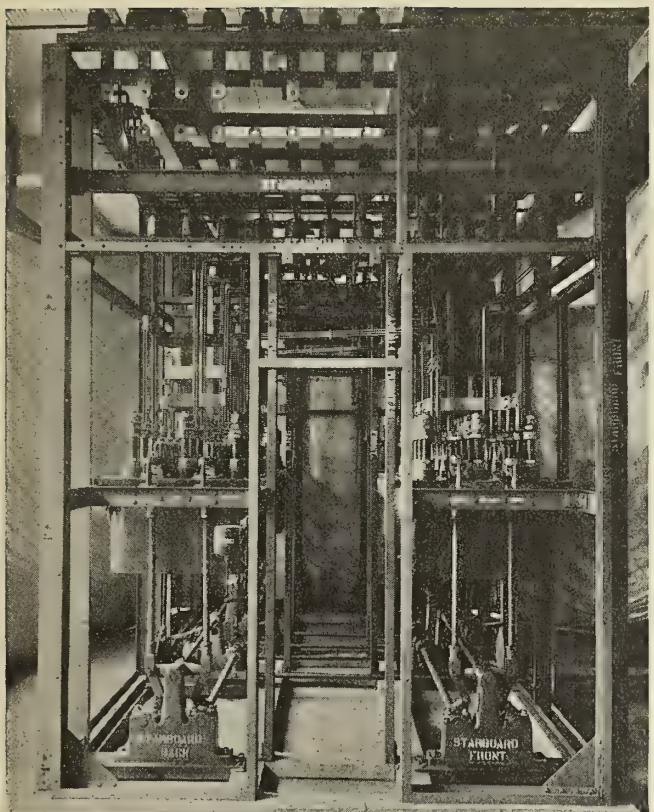


Fig. 22.—Propulsion Control Equipment; Starboard Side View, With Grille Work, etc., Removed

will not be made without corresponding increases in the field strength and it also insures that the turbine speed will be reduced before the reversal of the main motors is effected.

In addition to these interlocks, there is provided a balanced relay which is energized by the two phases of the generator and which is inoperative as long as the current strength in all four leads is the same; but if one of the phases should become short-circuited, the balance would be disturbed and this relay would trip out the main field switch.

Operation of the Machinery

The operation of the machinery is as follows:

(1) *Getting under way with one generator and motors on 36-pole connection.*—Assume that the ship is going to get under way with one generator and that the maximum speed will not be over 15 knots. This means that the

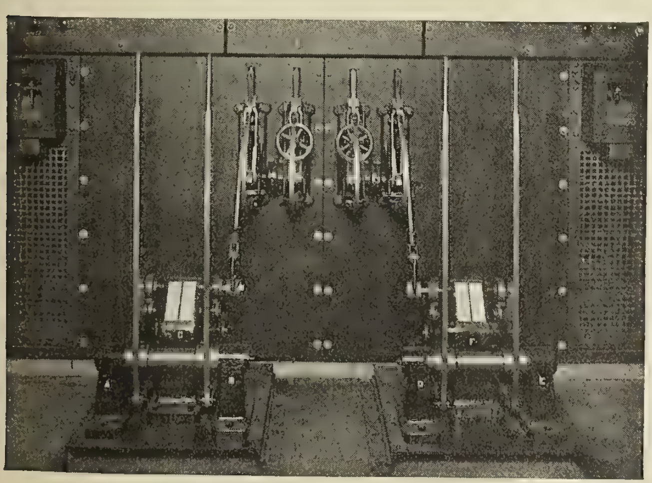


Fig. 23.—Steam Field and Motor Control Levers in Off Position

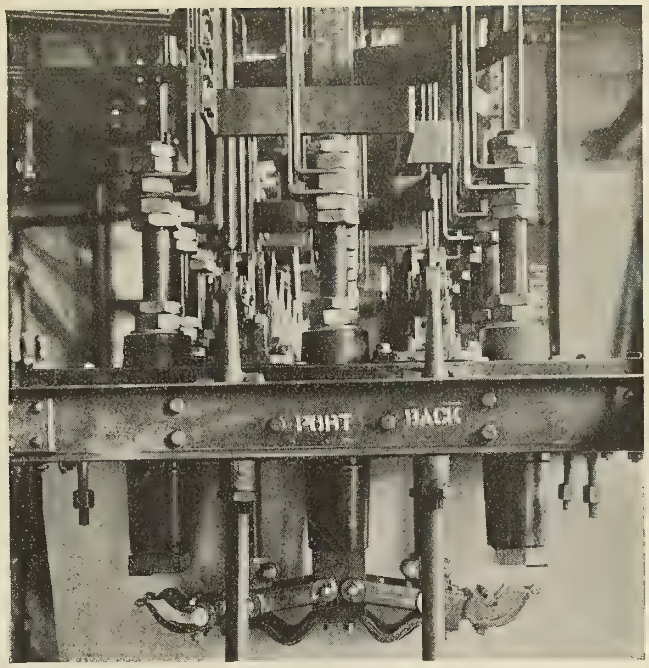


Fig. 24.—Propulsion Control Equipment; Detail View of Oil Switch

motors will be operated on the 36-pole connection. Before reporting ready to get under way, the generator that it is desired to use would be tested out and then set to run at low speed; the bus tie switch would be closed, and the generator disconnecting switch would be closed in the low-voltage position. The field switch of the generator and the pole-changing and reversing levers would be open. On receiving a bell "Ahead"—

(a) The pole-changing switch would be thrown in the "36-pole" condition.

(b) The reversing lever would be thrown in the "Ahead" position.

(c) The field switch would be closed and brought up to the desired field strength.

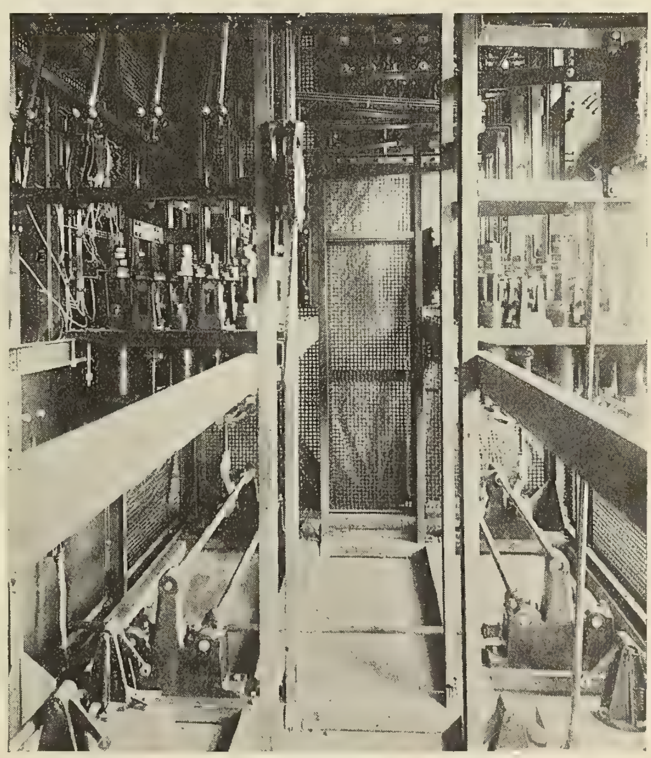


Fig. 25.—Interlocks Between Field Switch and All Other Switches

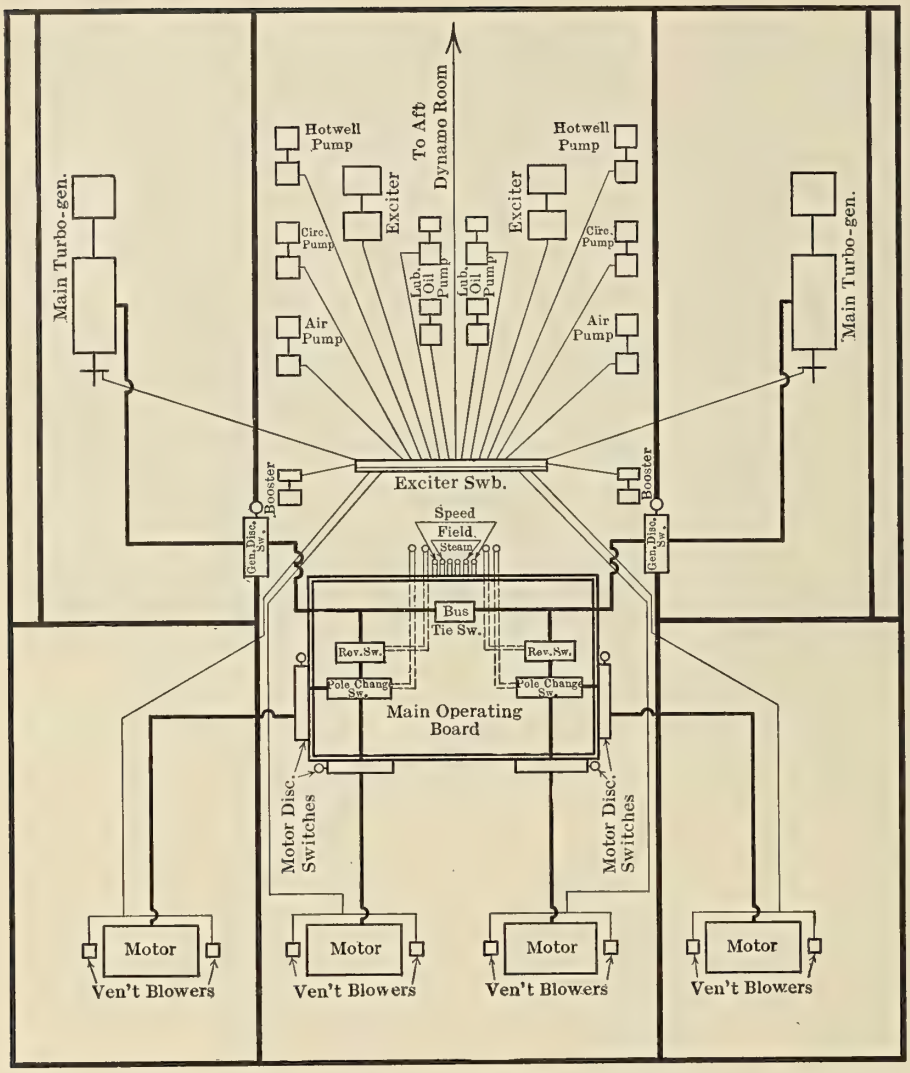


Fig. 26.—Diagram Showing General Arrangement of Propelling Machinery and Auxiliaries

(d) The turbine would then be brought up to the desired speed.

(2) *Reversing.*—With the ship going ahead under conditions described above, under (1), on receiving a bell "Astern"—

(a) The field switch would be opened and the speed lever brought to low speed at the same time.

(b) As soon as the under current relay operates, the reversing levers would be thrown to the "Astern" position.

(c) The field switch would then be closed and over-excitation applied to the generator until the motors have been reversed and come up to synchronous speed when the field would be reduced to its normal value.

(d) The speed of the turbine would then be brought up to whatever is desired.

(3) *Getting under way with one generator and motors on 24-pole connection.*—In case it is desired to make the maximum speed greater than 15 knots, but less than 17½ knots, one generator will be used and the motors will be connected on the 24-pole condition. In this case, getting under way is exactly as described under (1), except that the pole-changing switches would be thrown into the 24-pole position.

(4) *Reversing.*—Assuming the ship to have got under way with conditions as described above, under (3), on receiving a bell "Astern," reversal would be accomplished in the following manner:

(a) Open the field switch and throw the speed lever to low speed at the same time.

(b) Throw pole changers to 36-pole position.

(c) Throw reversing switches to "Astern" position.

(d) Apply over-excitation to the field of the main generator until motors have come into synchronism and then reduce field to normal value.

(e) Bring turbine up to desired speed.

(5) *Getting under way with two generators.*—In this case the bus tie switch would be open and the two generator disconnecting switches would be closed in the high-voltage position. Field switches would be open, generators would be running at slow speed, and pole-changing and reversing switches would be open. If bell "Ahead" is received, the operations carried out would be exactly as described under (3), except that it would be performed on two generators instead of one.

(6) *Reversing.*—After having got under way with conditions as above described, if a bell "Astern" were received the operations would be exactly as described under (4), except that they would be carried out for two generators instead of one.

Official Trials

The *New Mexico* has had two sets of official trials. The first trials were conducted after the ship had been out of dry dock about seven weeks, and this increased the shaft horsepower necessary to make the guaranteed speed of 21 knots by over 4,000 horsepower, so a second set of trials were run when the horsepower came down to 29,100 for 21 knots.

The ship averaged 21.08 knots for her four-hour full power run, and 21.31 knots was the average of the five high points on standardization. The turbine water rates were considerably better on the first trials than on the second, owing to the fact that the first trials were run in smooth water, while the second trials were run in rough weather, which increased the horsepower for the speed, and for which no allowance was made, as the standardization horsepower was used.

The water rates obtained in the trials were as follows:

Speed	Water Rate — First Trial	Water Rate — Second Trial
Full speed	12.29	12.01
19 knots	11.926	12.33
15 knots	11.667	12.475
10 knots	14.223	13.96

These water rates include the steam from the 300-kilowatt exciters, which furnished power for excitation and also for driving the main air pumps, main circulating pumps, main condensate pumps, forced lubrication pumps, and ventilating blowers for the main motors.

In addition to the trials for steam and fuel consumption, trials were made to demonstrate satisfactory backing qualities when steaming at full power; also to deter-

mine satisfactory performance when turning with full rudder and at full speed, both in the case of propulsion by one generator and also by two generators.

Numerous other trials were conducted, such as standardizing with two screws driving and two running idle, and considerable new data was obtained in regard to the action of screw propellers. In all the tests carried out the machinery gave very satisfactory performance.

TURBINE EQUIPMENT (see Fig. 7)

Part No.	Description of Apparatus	Name Plate Inscription
13	Steam limit control lever	Steam Limit Control Lever
14	Red bull's eye lamp for steam limit indicating switch	
15	Clear bull's eye lamp for steam limit indicating switch	
16	Speed control mechanism	Speed Control Mechanism
45	Steam gage	Main Steam
46	Steam gage	Main Turbine, Steam Chest
47	Steam gage	Main Turbine, First Stage
48	Steam gage	Exciter Exhaust
49	Steam gage	Auxiliary Exhaust
50	Pressure gage	Oil to Turbines
51	Pressure gage	Feed Water
52	Pressure gage	Oil to Governor
54	Vacuum gage	Main Condenser

GENERATOR EQUIPMENT (see Fig. 14)

Part No.	Description of Apparatus	Name Plate Inscription
1	Generator disconnecting switch, 8-p., d-t	Generator Disconnecting Switch
	* (A) Auxiliary switch, d-p., c. o	
	* (B) Magnetic locking device	
3	Balance relay	Balance Relay
6	Reversing lever mechanism	Ahead—Astern
	* (A) K-31 oil circuit breaker, 3-p., d-t., 5,000 volt, 3,000 amp	
	* (B) Magnetic locking device	
7	Interlock between reversing and pole-changing levers	
10	Field control mechanism	Field Control Mechanism
	* (A) Booster rheostat	
	* (B) Pipe mechanism for (A)	
11	Interlock between field control lever and reversing and pole-changing levers	
12	Interlock between bus section and field switches	
	* (A) Bus section switch, 4-p., s-t., 2,400 amp., 5,000 volt, operating mechanism and auxiliary switch	
17	Across-ship interlocking shaft for 12	
23	Red bull's eye lamp for field switch	Generator Field
24	Green bull's eye lamp for field switch	Generator Field
25	H-2 ammeter, 15 amp. with 10,000 amp. scale	Generator Ammeter
26	H-2 voltmeter, 150 volt with 6,000 volt scale	Generator Voltmeter
27	DH-3 temperature indicator $\left\{\begin{matrix}\text{70-250 deg. F.}\\ \text{20-120 deg. C.}\end{matrix}\right\}$ scale	Generator Temperature Indicator
28	DH-3 field ammeter, 600 amp. with shunt	Generator Field Ammeter
29	DH-3 field voltmeter, 300 volt	Generator Field Voltmeter
31	H-2 indicating wattmeter, 110 volt, 4 amp., 20,000 kw. scale	Generator Wattmeter
	* (A) E-18 current transformer, 3,000/5 amp	
	* (B) AQ-1 potential transformer, 4,400/110 volt, 200 w	
	* (C) Fuse support with fuse holder and fuse, 4,400 volt	
32	H-4 speed indicator, 110 volt, 1,000-2,600 r. p. m. scale	Generator Speed Indicator
39	Ammeter transfer switch	Generator Ammeter Transfer Switch
40	Voltmeter transfer switch	Generator Voltmeter Transfer Switch
41	Balance relay cut-out switch	Balance Relay Cut-Out Switch
42	Temperature indicator transfer switch	Temperature Coils
43	Temperature indicator test switch	Test
44	Temperature indicator supply switch	Indicator Supply
58	Interlock between generator disconnecting switches and bus section switch	
59	Booster generator field switch	Booster Generator Field

MOTOR EQUIPMENT (see Figs. 8-13)

Part No.	Description of Apparatus	Name Plate Inscription
2	Motor disconnecting switch, 8-p., s-t., 600 amp., 5,000 volt	
	* (A) Magnetic locking device	
5	Pole-changing lever mechanism	24 Poles—36 Poles
	* (A) K-31 oil circuit breakers, 6-p., d-t., 5,000 volt, 1,500 amp	
	* (B) Magnetic locking device	
8	Under current relay	Under Current Relay
9	Blue bull's eye indicating lamp for 8	
18	Revolution counter	
19	Stop clock—average starboard shafts	
20	Stop clock—average all shafts	
21	Stop clock—average port shafts	
30	IS-4 watthour meter, 110 volt, 5 amp	Motor No. 1 (or 3)
33	IS-4 watthour meter, 110 volt, 5 amp	Motor No. 2 (or 4)
	* (A) W-2 current transformer, 800/5 amp	
	* (B) AQ-1 potential transformer, 4,400/110 volt, 200 w	
	* (C) Fuse support with fuse holder and fuse, 4,400 volt	
34	H-2 ammeter, 5 amp. with 1,600 amp. scale	Motor No. 2 (or 3) A. C. Ammeter
35	H-2 ammeter, 5 amp. with 1,600 amp. scale	Motor No. 1 (or 4) A. C. Ammeter
36	Direction indicator motor No. 2 (or 3)	
37	Direction indicator motor No. 1 (or 4)	
53	Electrical speed indicator motor No. 2 (or 3)	
55	Electrical speed indicator motor No. 1 (or 4)	

* Located inside cell.

MISCELLANEOUS EQUIPMENT

Part No.	Description of Apparatus	Name Plate Inscription
4	Speed indicator for engine room telegraph	Starboard
22	Clock	Port
38A	Name plate	
38B	Name plate	
56	Lamp bracket	
57	Rudder position indicator	
60	Sheet iron protecting shield	

EXCITER SWITCHBOARD EQUIPMENT (see Figs. 17-19)

Part No.	Description of Apparatus	Name Plate Inscription
1	DH-3 ammeter, 150-0-150 amp. scale with shunt	Booster Motor
2	DH-3 ammeter, 200 amp. scale with shunt	Air Pump
3	D-27 lever switch, d-p., d-t., 250 volt, 135 amp	Air Pump Bus No. 1
4	D-27 lever switch, d-p., d-t., 250 volt, 135 amp	Air Pump Bus No. 2
5	DH-3 ammeter, 1,500 amp. scale with shunt	Main Circulating Pump
6	D-27 lever switch, t-p., d-t., 250 volt, 1,200 amp	Main Circulating Pump—Bus No. 2
7	D-27 lever switch, t-p., d-t., 250 volt, 1,200 amp	Main Circulating Pump—Bus No. 1
8	DH-3 ammeter, 100 amp. scale with shunt	Hotwell Pump
9	D-27 lever switch, d-p., d-t., 250 volt, 65 amp	Hotwell Pump—Bus No. 1
10	D-27 lever switch, d-p., d-t., 250 volt, 65 amp	Hotwell Pump—Bus No. 2
11	D-27 lever switch, d-p., d-t., 250 volt, 65 amp	Lubricating Oil Pumps—Bus No. 1
12	D-27 lever switch, d-p., d-t., 250 volt, 65 amp	Lubricating Oil Pumps—Bus No. 2
13	D-27 lever switch, s-p., d-t., 250 volt, 350 amp	Booster
14	D-27 lever switch, s-p., d-t., 250 volt, 350 amp	Generator Field
15	D-27 lever switch, s-p., d-t., 250 volt, 350 amp	Bus
16	D-27 lever switch, d-p., d-t., 250 volt, 135 amp	Ventilating Blower No. 1 (or 4) Bus No. 1
17	D-27 lever switch, d-p., d-t., 250 volt, 135 amp	Ventilating Blower No. 1 (or 4) Bus No. 2
18	D-27 lever switch, d-p., d-t., 250 volt, 135 amp	Ventilating Blower No. 2 (or 3) Bus No. 1
19	D-27 lever switch, d-p., d-t., 250 volt, 135 amp	Ventilating Blower No. 2 (or 3) Bus No. 2
20	Switch stop for 65 amp., d-t. lever switch	
21	Switch stop for 350 amp., d-t. lever switch	
22	Switch stop for 135 amp., d-t. lever switch	
23	Name plate	Starboard
24	Name plate	Port
25	Clear bull's eye indicating lamp	Blower No. 41
26	Clear bull's eye indicating lamp	Blower No. 43
27	Clear bull's eye indicating lamp	Blower No. 42
28	Clear bull's eye indicating lamp	Blower No. 44
29	Clear bull's eye indicating lamp	Blower No. 47
30	Clear bull's eye indicating lamp	Blower No. 51
31	Clear bull's eye indicating lamp	Blower No. 49
32	Clear bull's eye indicating lamp	Blower No. 53
33	Clear bull's eye indicating lamp	Blower No. 54
34	Clear bull's eye indicating lamp	Blower No. 50
35	Clear bull's eye indicating lamp	Blower No. 52
36	Clear bull's eye indicating lamp	Blower No. 48
37	D-27 control bus transfer switch, t-p., d-t., 250 volt, 65 amp., with resistance	After Distribution Board
38	D-27 control bus transfer switch, t-p., d-t., 250 volt, 65 amp., with resistance	Three-Wire, D. C. Control Buses
39	D-27 control bus transfer switch, t-p., d-t., 250 volt, 65 amp., with resistance	To Control Bus Selector Switch
40	D-27 lever switch, t-p., d-t., 250 volt, 65 amp	Exciter No. 2
41	D-27 lever switch, t-p., d-t., 250 volt, 65 amp	Exciters
42	D-27 lever switch, t-p., d-t., 250 volt, 65 amp	Exciter No. 1
43	Solenoid operated field switch, d-p., s-t., 250 volt, 350 amp	Generator Field—Starboard
44	Solenoid operated field switch, d-p., s-t., 250 volt, 350 amp	Generator Field—Port
45	D-27 lever switch, s-p., d-t., 250 volt, 350 amp	Generator Field, 240 Volt
46	D-27 lever switch, s-p., d-t., 250 volt, 350 amp	Generator Field, 120 Volt
47	DH-3 ammeter, 2,000 amp. scale with shunt	Positive Ammeter
48	DH-3 ammeter, 2,000 amp. scale with shunt	Negative Ammeter
49	DH-3 voltmeter, 300 volt scale	Starboard (or Port) Voltmeter
50	Voltmeter transfer switch, d-p., 6-t	Bus, Voltage, Grounds Pos. Neg.—Pos. Neu.—Neu. Neg.—Pos. Grd.—Neu. Grd.—Grd. Neg.
51	Field rheostat mechanism	
52	D-27 lever switch, s-p., s-t., 250 volt, 350 amp	Booster Generator, Neg.
53	D-27 lever switch, s-p., s-t., 250 volt, 350 amp	Booster Motor, Neg.
54	H-16 starting switch, s-p., 4-t., 250 volt, 150 amp	Booster Motor Starter
55	Mechanical interlock between booster motor starting switch and generator field switch	
56	D-27 lever switch, t-p., 6-t., 250 volt, 1,800 amp	Bus No. 1
57	D-27 lever switch, t-p., 6-t., 250 volt, 1,800 amp	Starboard Exciter
58	D-27 lever switch, t-p., 6-t., 250 volt, 1,800 amp	Bus No. 2
59	D-27 lever switch, t-p., 6-t., 250 volt, 1,800 amp	After Distribution Board
60	D-27 lever switch, t-p., 6-t., 250 volt, 1,800 amp	Port Exciter
61	Bureau name plate	
62	Name plate	New Mexico
63	Lamp bracket	
64	Solenoid control relay, s-p., 125 volt	
65	Generator field discharge resistance	
66	Fuse base	
67	Lamp bracket	

Electric Drive on Merchant Ships

**Comparison of Electric Drive With Reduction Gearing—
Electric Propulsion of Single-Screw Cargo Vessel Proposed**

BY W. L. R. EMMET*

JUSTIFICATION for electric drive on merchant ships is that it affords a transmission efficiency practically equal to that obtainable with gears of suitable speed reduction, and that it accomplishes this result by a simpler and more reliable means. The writer has given much thought to this problem, both with respect to geared equipments and to electric drive, has conducted many experiments, and obtained much practical experience. A year or two ago he was of the opinion that electric drive would not be commercially justified on low-speed merchant vessels on account of higher cost and a somewhat less transmission efficiency. More correct studies of this subject and the development of improved electrical methods have shown that the difference of transmission efficiency is very slight and that the small difference of cost which will apply to a just comparison is much more than justified by many practical advantages accomplished.

Geared turbine applications to merchant ships have been of two kinds: first, single-reduction equipments with relatively low-speed turbines, and, second, double-reduction equipments with high-speed turbines. The General Electric Company was the first to produce equipments of the latter type, which afford a less efficient transmission but admit the use of a very much better and simpler turbine. By the introduction of single-reduction turbine equipments, Parsons showed by comparative tests a reduction in steam consumption of about 19 percent as compared with the reciprocating engine. Four years ago I predicted a further reduction of 14 percent by the use of high-speed turbines with double-reduction gearing, and very complete data and tests have proved the correctness of this prediction.

Single-Reduction Gears Abandoned in British Ships

An interesting fact in this connection is that in recent designs Parsons has abandoned the single-reduction method, and the new standard English ships are being built with double-reduction gearing and high-speed turbines. At the same time that this change is being carried on on a large scale in England, the DeLaval Company and others in this country, with the approval of the Emergency Fleet Corporation, have made the opposite change and have abandoned double reduction in favor of single reduction, on the ground that the gearing could be made more reliable. An interesting fact in this connection is that the principal troubles with marine gears have developed in the low-speed element.

These facts illustrate the uncertainties of the gear situation and the unformed state of opinion relating to it.

Machinery which drives a propeller may be subject to very severe shocks and periodic vibrations, and gear troubles have developed on ships in a manner which seems erratic and very difficult of classification.

The efficiency of ship gears has also been overestimated. Careful tests have indicated that the efficiency of transmission in a 2,500-horsepower double-reduction equipment, running smoothly and in good condition, does not exceed 94.5 percent, and it must be remembered that the equipment is further handicapped by the presence of a reversing turbine which occasions about eight times as much friction resistance as a similar turbine moving in the ahead direction. With high-speed turbines and the most improved electrical apparatus, we can get a transmission efficiency of 93.5 percent on such a ship, so that it can be safely predicted that in any vessel in which high-speed turbines are used, the difference of transmission efficiency will not exceed one percent. If, on account of gearing conditions, the turbine has to be divided into two or more parts, there is a further disadvantage through increased packing losses and other complications.

Effects of Temperature With Use of Reversing Turbines

Another matter which is important in the comparison of geared and electric ship equipments is the effects of temperature which may arise in connection with the use of reversing turbines, particularly where high degrees of superheat are applied. In an electrically driven ship the turbine always moves in the same direction and never requires to be stopped except when operation is entirely discontinued. Thus its service is equivalent to that of a turbine on shore. When a turbine is operated in the reverse direction the friction is at least eight times as great as in the normal direction. The reversing elements of our 2,500-horsepower ship turbines, although very small in diameter and of a minimum rotation loss, will, when operated in a 10-inch vacuum at full speed, heat up enough to turn blue. In our tests we regularly avoid this by introducing water. The introduction of water or any fluid which may limit this heat will naturally cause a large increase of loss.

An experiment which suggests the possibilities of such heat troubles as have been mentioned was recently made in Schenectady. A turbine designed to operate at 3,600 revolutions per minute was forced to revolve in the reverse direction at 2,000 revolutions per minute. A small amount of steam, passed through the buckets in the normal direction while it was being reversed, produced in a short time a temperature of 940 degrees F. in the nozzles of the last stage.

Temperature variations in actual practice in ship turbines are, to a great extent, limited by the heat storage capacity of the turbine parts themselves, but there are bound to be local heatings and irregular distributions of heat, which, with high superheat, cannot fail to be a source of increased danger. Superheat affords means of greatly increased economy wherever turbines are used, and this advantage should not be sacrificed in ships where fuel economy is of such great importance. In an electrically driven ship superheat can be a source of no disadvantage to a turbine—in fact, it is likely to increase the life of the blading.

Electrical Propulsion Limited by Propeller Speed

The electrical propulsion of ships may be limited under some conditions by the matter of propeller speed, since we cannot have less than two poles in the generator, and since it is undesirable to have to provide more than 60 or 70

* Consulting engineer, General Electric Company, Schenectady, N. Y.

poles in a motor. For ships requiring 3,000 horsepower or over and a speed of about 11 knots, a turbine operating at 3,000 revolutions per minute can be advantageously used, which, with a 60-pole motor, will give 100 revolutions per minute to the propeller and a high propeller efficiency. In higher speed vessels the conditions are generally easier. With smaller powers and propellers operating under 100 revolutions per minute it will generally be desirable to use gears, even if electrical transmission is adopted. In that case it is desirable to place the gears between the turbine and the generator instead of between the motors and propellers, as has been done.

Difficulties in Low-Speed Elements of Gearing

Experience with ship gearing indicates that the greatest difficulties arise in the low-speed elements. This is probably due to the fact that these elements receive more direct shocks from the propeller, and also that they give a much less perfect lubrication effect. There is presumably an effective oil cushioning in high-speed gears which is absent in low-speed gears.

In electric drive equipments it would generally be desirable to furnish direct current exciting current from a separate source, and it has been thought desirable to combine excitation, lighting and the driving of auxiliaries. The auxiliaries on most existing ships involve a considerable unnecessary loss of power, and by driving them electrically and exhausting a well-designed auxiliary generating unit into the feed heater and into an intermediate stage of the turbine, a very good efficiency and simple operating condition can be afforded.

The following copy of a proposal recently made illustrates the possibilities of an application to a 4,000-horsepower vessel with a single screw operating at 110 revolutions per minute:

Proposal for Electric Drive on 4,000-Horsepower Merchant Vessel

"The auxiliary generating units are of such a size that one of them will be capable of affording lighting and excitation and all the auxiliary power which has been contemplated while the ship is at sea. These units are designed to run condensing or non-condensing with a good water rate. By carrying as a spare part a suitable direct-current motor and gear which could be connected to the end of the main shaft, these auxiliary units are used to propel the ship at nearly half speed in case the main unit or main motor were unfit for service. It would in any case be desirable to have auxiliary condensing facilities for use in port, and these could be used in such an emergency.

"The main propulsion equipment consists of:

	Approximate Net Weight, Pounds
One 3,200-k. v. a., 3,500 revolutions per minute, 2,500-volt turbine generating unit..........	82,000
One 4,000-horsepower, 110 revolutions per minute, alternating-current motor..........	80,000
Instruments and controlling mechanism for the above	9,000

"Our calculations concerning the performance of this equipment show the following results, and, since the efficiency of every part is thoroughly understood, it is certain that these results can be actually obtained in practice. When the turbine is operating with a steam pressure of 265 pounds gage at the throttle, 150 degrees F. superheat, and 28.5 inches vacuum, we should obtain a brake horsepower delivered to the propeller shaft with 9.4 pounds of steam, not including auxiliary steam.

"In giving guarantees, we must make an allowance for possible errors in testing and will guarantee that this water rate, under these conditions, will not exceed 10 pounds per shaft horsepower hour.

"*Auxiliaries.*—We have assumed that the boiler feed pump is steam-driven and requires 2,500 pounds of steam per hour, also that a Blake twin-beam wet and dry air pump is used which consumes 600 pounds of steam, making a total of 3,100 pounds of steam from these pumps for feed water heating. The following electrically driven auxiliaries have been assumed:

	Motor Speed	Horsepower	Electrical Input, Horsepower
Circulating pump..	1,700/1,000	75.00	82.5
Excitation		80.00	80.0
Lighting		20.00	20.0
Oil cooler.........	1,700	1.25	1.5
Fire room blowers.	850	20.00	22.5
Steering	800	5.35	6.0
Continuous load....................			212.5 = 157.0 kilowatts

	Motor Speed	Maximum Horsepower	Average Continuous Horsepower
Sanitary pump.....	1,700	5.0	2.5
Fresh water pump..	1,700	5.0	2.5
Refrigerating pump.	1,700	5.0	2.5
Evaporator pump..	1,700	1.0	1.0
Workshop	1,700	5.0	2.5
Bilge pump.......	850	5.0	5.0
			16.0
Total input.......................			18.0 = 13.5 kilowatts
Total maximum load..............			170.5 kilowatts

"In addition to the above motors there is included one 20-horsepower, 900 revolutions per minute induction motor for operating the blower for main motor ventilation. In connection with the above motors, while we are including hand-operated starting devices, no mechanical parts such as pumps, blowers, etc., are included. In other words, only motors and starters are included.

"We propose to drive these auxiliaries from two 150-kilowatt, direct-current sets, operating non-condensing against a back pressure of 5 pounds gage, with part of this exhaust used to bring up the fed water temperature to 212 degrees F. and the remainder going into a suitable stage in our turbine for additional work.

"The total flow of steam from the boiler at maximum speed will be 43,000 pounds per hour. Assuming 14 pounds of steam evaporated per pound of oil (same efficiency as Babcock & Wilcox boilers on battleship *Wyoming*), this would require 3,100 pounds of fuel oil per hour, or 33.25 tons (2,240 pounds) for 24 hours. Thus the water rate, including all auxiliaries, lighting, and steam required for heating feed water, should be 11.1 pounds per shaft horsepower hour.

"The electrical apparatus proposed for this purpose is of an extremely simple and reliable type. Our records over long periods of years covering such apparatus show that only about one-tenth of one percent of the motors and generators of such voltage, which are installed in all kinds of service, show any electrical trouble in a period of ten years.

"The turbine is of the most efficient type manufactured for such a capacity and is designed with very liberal factors of safety with all the most recent features of construction. Such a turbine is capable of running at a considerable proportion of its capacity if one of its many wheels is in operating condition. Packings, bearing sleeves and other perishable parts are easily replaceable, so that under almost any combination of circumstances such a turbine can be quickly got into operative condition after it has been accidentally damaged.

"The standards of reliability are so high with such apparatus that it is believed that they occasion less risk of stoppage than is incurred in single-screw ships propelled

in any other manner. In case, however, the novelty of such an equipment raises doubts which may increase insurance rates, a motor can be provided as stated above which will propel the ship at reduced speeds from power delivered by the auxiliary generating units.

"It is believed that the operation of these relatively large auxiliary generating units and the use of motors for driving the auxiliaries mentioned are justified from the standpoint of economy. Generating units of such a capacity will give a very good efficiency, and their operation involves no more complication of detail than is occasioned by the use of the smallest steam turbine—in fact, the details of the larger turbine are simpler and better than those of the smaller one."

The proposal quoted above describes an equipment which is in itself much less liable to trouble or interruption than any type of existing equipment used on a single-screw ship, and at the same time affords, at very small cost for spares, means by which the ship can be run if the main machinery is inoperative. The figures given as to results are correct and dependable, and are so good that their accomplishment in many classes of service would pay for the change in three years. With very few exceptions, the prevailing opinion of the most experienced marine engineers is that the reciprocating engine for ship propulsion is obsolete. Its replacement is inevitable, and the General Electric Company, with its experience and facilities for development, is ready to do the work.

United States 110-Foot Submarine Chasers

Description of Special Type of Naval Vessel Which Played an Important Part in the War—Construction, Equipment and Engineering Data

BY R. P. SANBORN

SINCE the signing of the armistice and the subsequent modification of the censorship, a great deal of information has been published regarding the exploits of the American 110-foot submarine chasers, or the "110-footers," as they are popularly known. For that reason a short description of these vessels, their constructive features, arrangement and equipment may be of interest at this time.

When, early in 1917, it appeared certain that the United States would enter the war, the Navy authorities in making their preparations took account of the valuable services rendered England by her fleet of motorboats, fishing boats and other small craft, including the now famous 80-foot "M. L.'s," and took steps to provide a similar fleet for the protection of our own coast and harbors and to give our share of assistance in the offensive warfare against the submarine overseas.

The subject of patrol boats had received the attention of motorboat enthusiasts, yacht builders and designers throughout the country, and these men were called upon to give of their experience. Taking advantage of the experience of the Russians with their 60-footers and the British and Italians with their 80-footers, the department decided upon 110 feet as the minimum length for military efficiency and the maximum length for greatest production in the yards of motorboat builders throughout the country. Thirty-two boat builders located on the Atlantic Coast, Gulf of Mexico, Mississippi River and Great Lakes, together with four navy yards on the Atlantic Coast and two on the Pacific Coast, contributed the 341 submarine chasers constructed for our own navy and the 100 delivered to the French Government.

When the question of type, speed and general dimensions of hull had been decided upon, the Bureau of Construction and Repair under Rear-Admiral D. W. Taylor, U. S. N., assisted by Commander J. A. Furer, U. S. N., and Lieutenant-Commander A. Loring Swasey, U. S. N. R. F., assumed the task of working out the hull details.

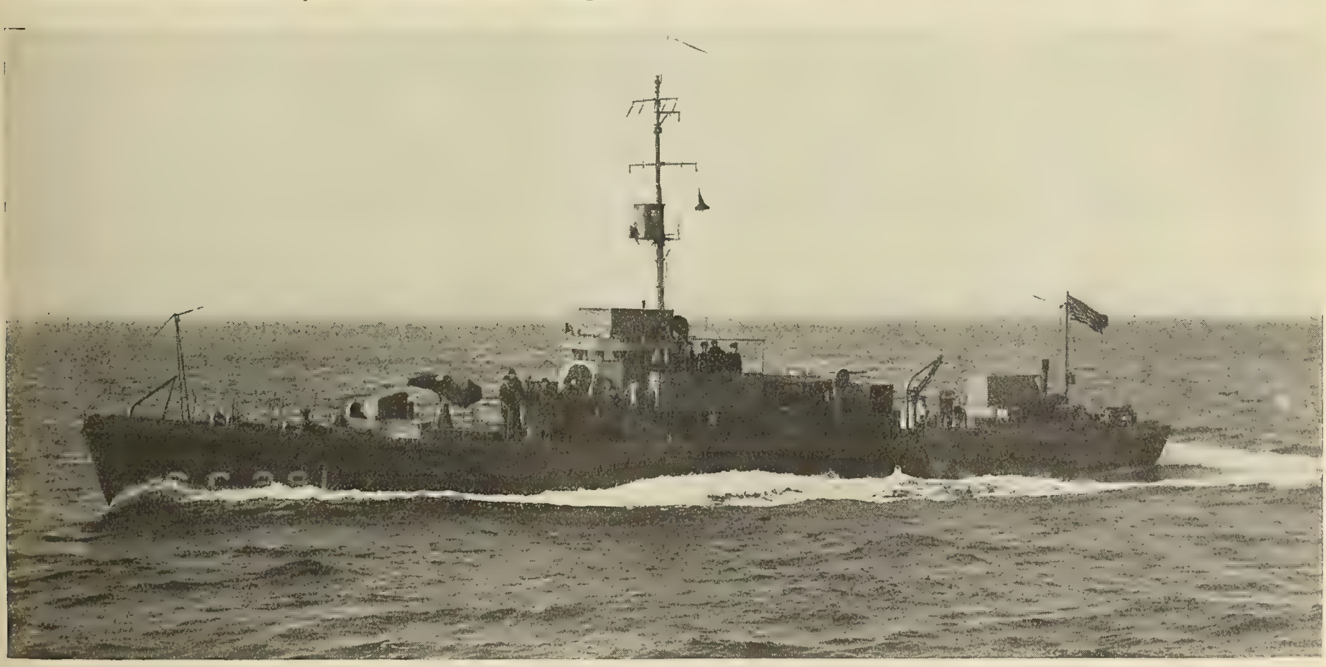
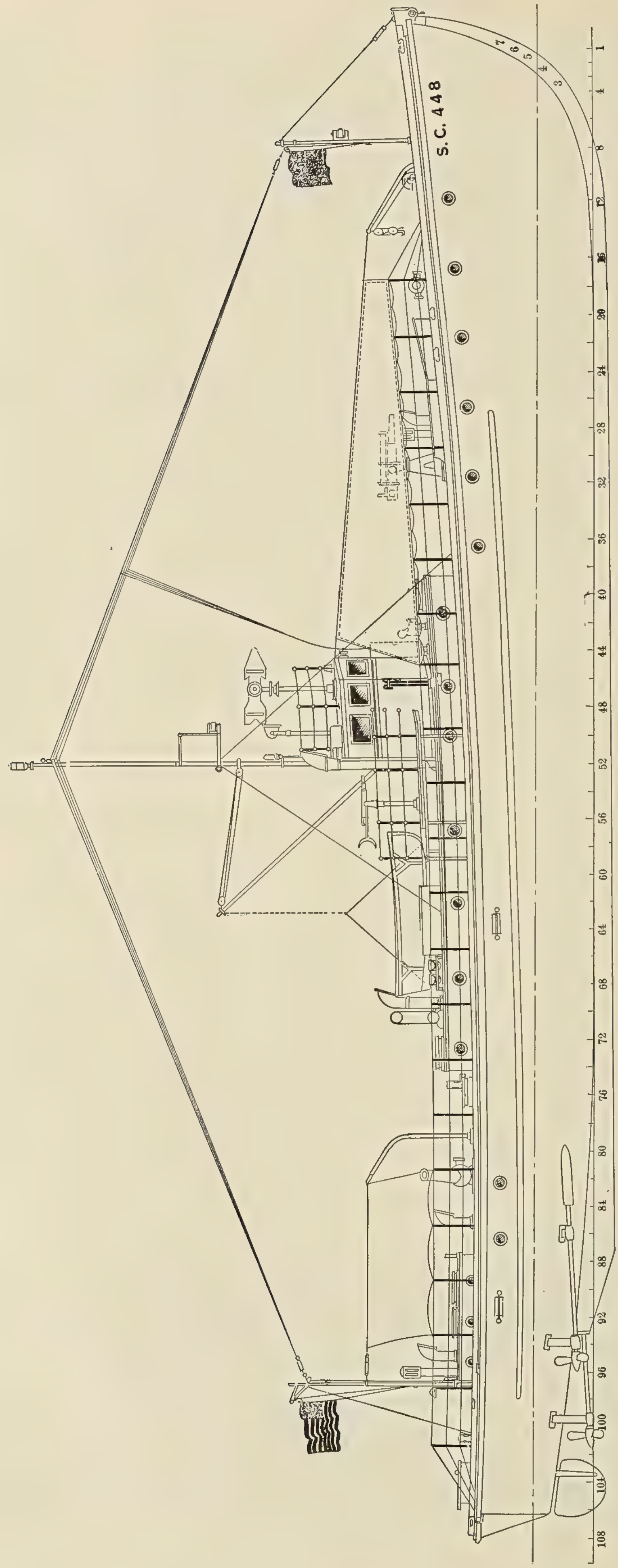
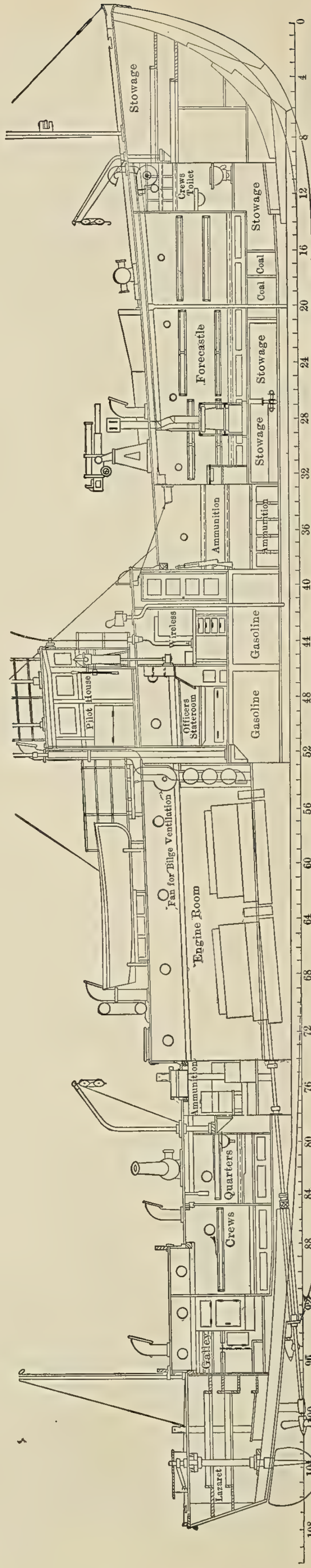


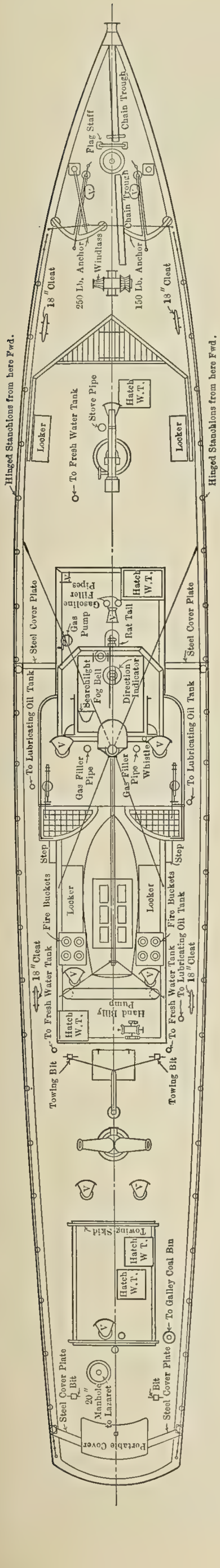
Fig. 1.—United States Submarine Chaser Fully Equipped Ready for Service



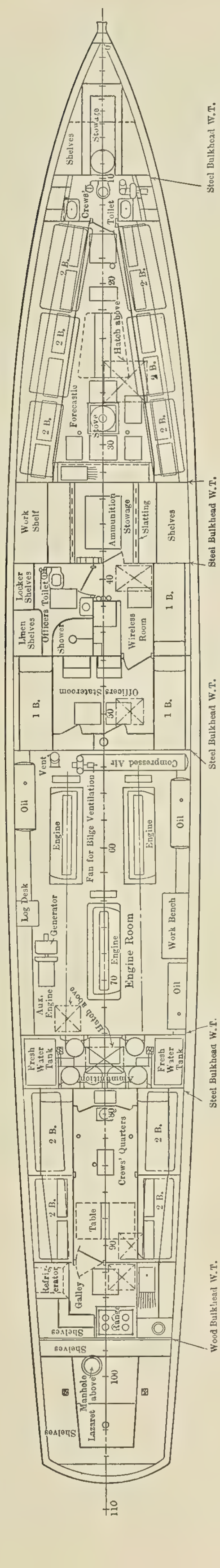
OUTBOARD PROFILE
Fig. 2



INBOARD PROFILE
Fig. 3



DECK PLAN
Fig. 4



INBOARD ARRANGEMENT PLAN
Fig. 5

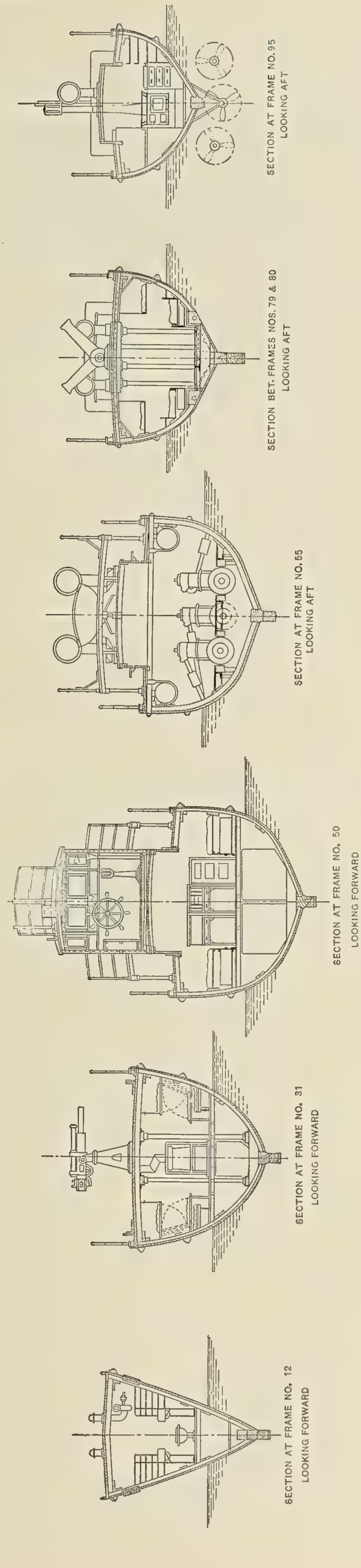


Fig. 6

The Bureau of Steam Engineering, under Rear Admiral R. S. Griffin, U. S. N., and Commander J. O. Fisher, U. S. N., turned its attention to the problem of supplying suitable machinery equipment.

Steam turbine drive was considered but soon discarded in favor of the gasoline (petrol) engine on account of excessive weight and space required for the former, and also because practically the entire output had been assigned to destroyers. The original layout called for a twin-screw arrangement, but, in order to provide sufficient power to attain the emergency speed specified by the General Board, the three-engine triple-screw arrangement was finally adopted.

When the bids for machinery were opened it was found that most of the engines of sufficient horsepower offered were of the high-speed type. On account of the extremely heavy work to be required of these little vessels and the long periods at sea in all kinds of weather, the slow-speed heavy-duty type was the only one considered suitable by the department.

Another factor that had to be considered in the choice of motive power was rapidity of production. The distribution of contracts for 355 chasers among thirty-eight different yards all prepared to start work at once meant that an immense number of engines would have to be delivered over a short period of time. The Standard Motor Construction Company, Jersey City, N. J., was just completing the contract for two-engine equipments for the 550 British "M. L.'s" built by the Elco Company in such a remarkably short time. The proposition was put up to Mr. Eugene A. Riotte, president of the Standard Company, with the result that on March 21, 1917, a contract was signed calling for delivery of the first set of engines in six weeks and a gradually increasing rate of production up to ten complete sets, consisting of three engines, auxiliaries and fittings, per week.

In spite of many difficulties in securing raw materials and finished parts from outside manufacturers this schedule was very closely adhered to. How close is indicated by the fact that the 355th set left the Standard factory in Jersey City on April 11, 1918, 386 days after the signing of the first contract. As soon as delivery of engines was started the Standard Motor Construction Company placed in the field a corps of expert operators to aid in the machinery installations and running of the trials, and it was a common occurrence for three and four telegrams to be received by the Navy Department in one day, each announcing the completion of another of the small warships.

General Dimensions of the 110-Footers

The following table gives the general dimensions of the vessels:

Length overall	110 feet
Length between perpendiculars	105 feet
Breadth, extreme over guards	15 feet 4¾ inches
Draft, extreme from load waterline	5 feet 11 inches
Displacement for 5 feet 3 inches mean draft	75 tons
Freeboard, minimum to load waterline	3 feet 11 inches
Extreme height, mast above load waterline	38 feet 2 inches
Extreme height, pilot house above load waterline	14 feet 8 inches

Designed with seaworthiness as of prime importance, the little vessels have proved the wisdom of their designers. Four watertight steel bulkheads, one watertight wooden bulkhead, and two non-watertight steel bulkheads divide them into eight compartments.

Strength with minimum weight marks their construction throughout. Steam-bent white oak frames are spaced twelve inches apart except in the engine compartment, where they are doubled. Keels are of yellow pine and oak; bilge stringers, hogging girder, shelf, clamp and sister clamp are all of yellow pine, and these are tied together with the seven bulkheads to give great longitudinal strength. Long leaf yellow pine is used for planking, and decks are of Port Oxford cedar or Oregon pine, with white oak and yellow pine deck beams. Stems and stem knees are of white oak. Transoms are planked on the outside with mahogany, on the inside with cedar or white pine, and framed and stiffened with white oak.

The foundations for the 3-inch anti-aircraft gun forward and the depth-charge projector or "Y" gun aft are heavily reinforced with steel diagonals, plates, web-frames, wood-blocking and heavy pipe stanchions.

The engine foundations are extremely heavy, and one noticeable feature of these vessels is the absence of vibrations at all speeds.

General Arrangement

A watertight steel bulkhead at frame No. 10 separates the forepeak stowage space from the forecastle which runs to another steel bulkhead at frame No. 33. The forecastle has living accommodations, including pipe berths, stowage space for clothing, mess tables, etc., for fourteen members of the crew. In here is also the boiler of the hot water system for heating the vessel, and in the forward end is the crew's toilet.

Aft of the forecastle is the forward ammunition locker with racks for stowing the three-inch ammunition and a small arms rack on the after bulkhead. The submarine-detecting devices and other special equipment are also located in this compartment, which communicates directly with the radio room. The latter room is on the starboard side and contains the ½-kilowatt wireless telegraph set, radio telephone set and living accommodations for the operator. Opposite the wireless room is the completely equipped officers' toilet, a unique feature of which is the shower bath with hand-operated pump. Aft of these two rooms, and separated by a wooden bulkhead is the officers' stateroom. This is equipped with spring bunks, desks, mess table, closets and lockers for the two commissioned officers. A hatch gives access to the pilot house directly above.

In the pilot house, in addition to the usual binnacle and other navigating instruments, are the radio telephone, plotting board for plotting the bearings of enemy submarines, as reported by the "listeners" on the various chasers, running and signaling light control switches and push buttons for operating the general alarms and depth bomb dropping signals. Speaking tubes connect with the crow's nest, engine room, radio and listening rooms and the officers' quarters, so that in time of action the commanding officer is in complete control of all parts of his vessel.

Under the officers' quarters and wireless room are the four 600-gallon gasoline (petrol) fuel tanks. The tanks are not interconnected, and only the two after tanks are piped to the engine float boxes, but a manifold and motor-driven pump are provided for transferring fuel from the forward to the after tanks. Filling pipes and air vents are led to the deck. Reach rod extensions to the main fuel stop valves are also brought to the deck just abaft the pilot house, so that in case of fire in the engine room the gasoline (petrol) supply may be cut off from the deck.

A watertight steel bulkhead separates the officers' stateroom from the engine room, and the other two watertight steel bulkheads are between the engine room and after ammunition compartment, in which are the depth charges

and fresh water tanks, and between this compartment and the after quarters for petty officers and engine room force. Next in order come the galley and lazarette.

A feature that impresses the visitor to these vessels is their compactness without being cramped, and nowhere is this more apparent than in the engine room. In a compartment approximately 21 feet by 14 feet are located three 220-horsepower Standard main engines and all auxiliaries, switch boards, batteries, oil and air tanks, work benches, etc., and yet there is no cramping at the control stations and there is plenty of space about the engines for inspection and repair. The two wing engines are in the forward end of the compartment so that there may be plenty of space around the control stations, which are at the after end of each engine. By each engine is hung a lubricating oil tank, and on the forward bulkhead are the air tanks, fuel transfer pump and blower for clearing the bilge of fumes.

In the after end of the compartment on the port side are the auxiliary engine, battery charging rheostat and the switchboard controlling all electrical circuits. On the starboard side is a work bench with tool rack above and the two sets of storage batteries underneath. Tachometers and revolution counters for each shaft are on the after bulkhead.

Headroom is ample throughout the compartment. Two 10-inch ventilators, with cowls, at each end of the compartment, a large skylight in the rook of the trunk and numerous portholes afford sufficient ventilation.

Engines

The main engines themselves deserve no little comment. Of the slow-speed, heavy-duty type, they have stood up admirably under the service required by 3,000-mile voyages across the Atlantic, months of patrol and convoy duty in all kinds of weather, and none too expert handling

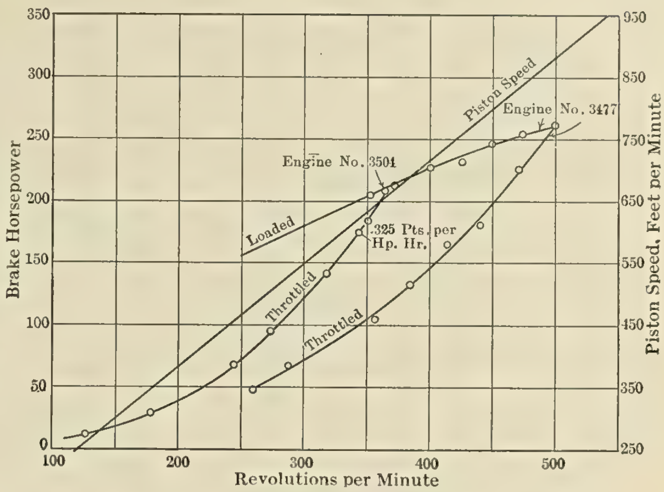


Fig. 8.—Curves Showing Engine Performance

by inexperienced machinist mates, most of whom were of the Naval Reserve Force, to which they have been subjected.

Rated to develop 220 horsepower each when turning 460 revolutions per minute, they are described as of the vertical, inverted, single-acting, four-cycle type, with six cylinders, 10-inch bore by 11-inch stroke. The crank cases

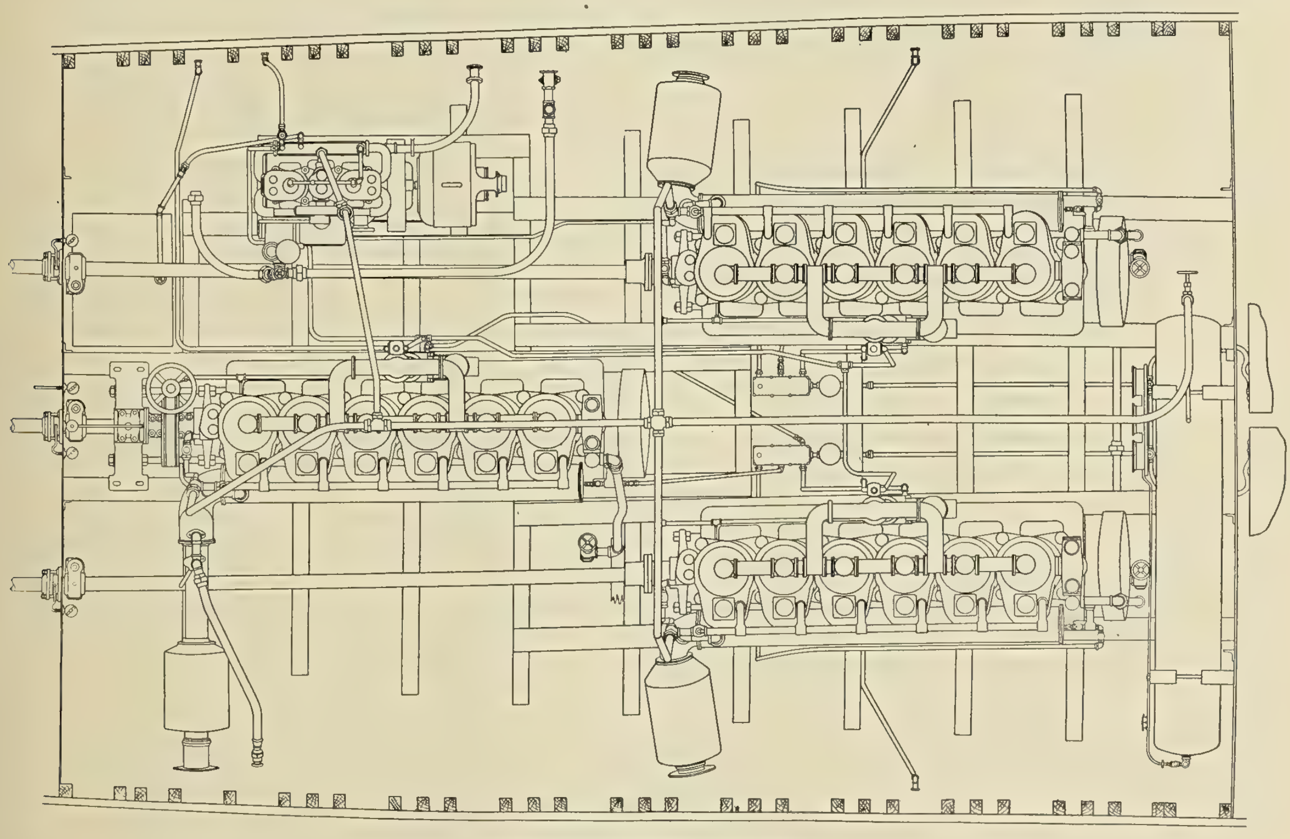


Fig. 7.—Plan of Engine Room

are open and the cylinders are mounted on steel stanchions amply crossbraced, the whole set on a heavy cast iron base. The total weight of each engine is about 6,300 pounds.

The cylinders are cast singly, amply water jacketed and the cylinder heads are removable. The engines are coupled directly to the propeller shafts, reversing being accomplished by fore and aft shifting of the valve cams and shaft, throwing into operation the proper cams for ahead or reverse, as the case may be.

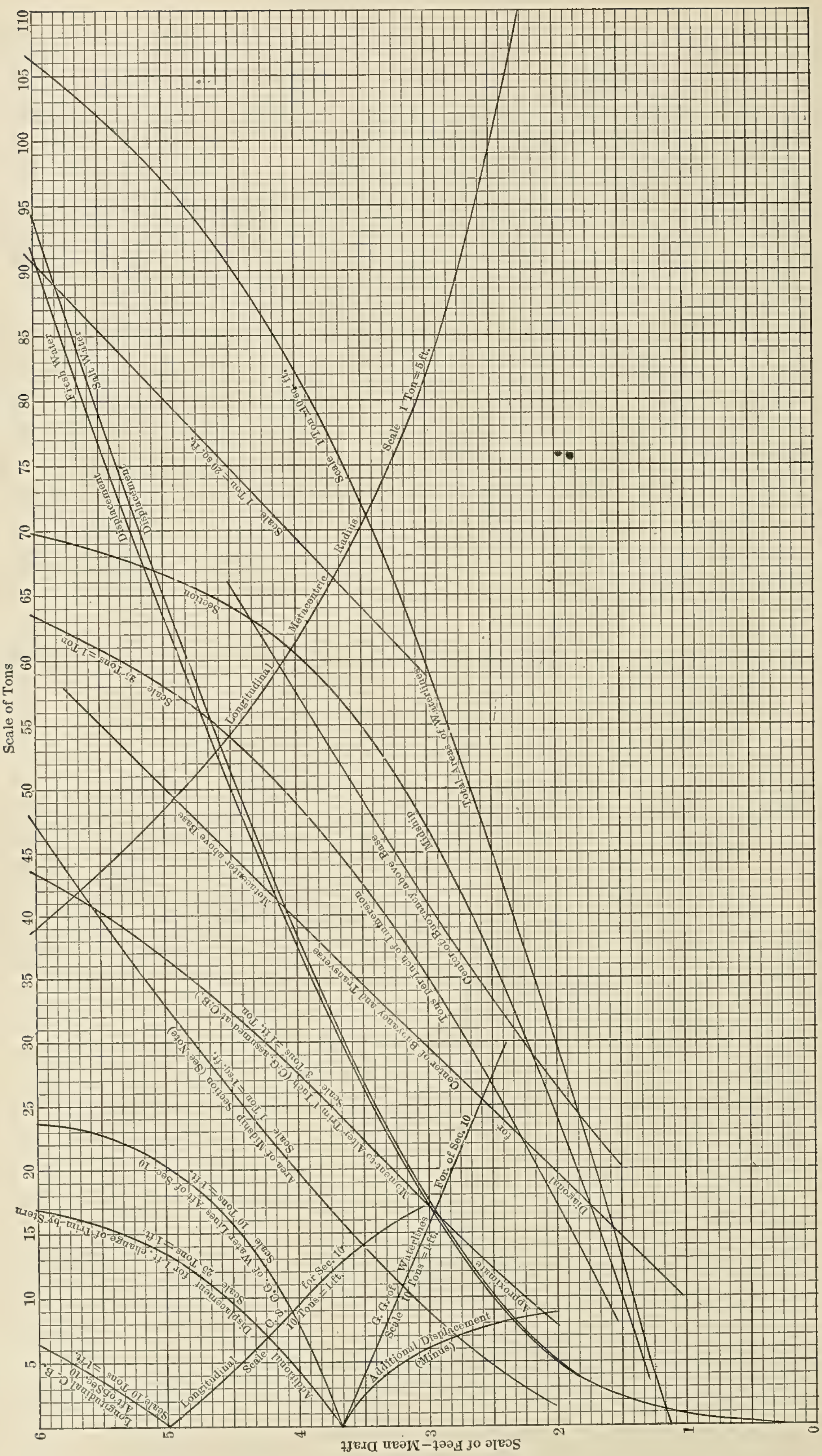


Fig. 9.—Displacement and Other Curves of 110-Foot Submarine Chasers

NOTE.—The above areas are exclusive of that portion of the keel below the base line of calculations

Starting is accomplished by compressed air entering into the six cylinders through valves operated by cams. A reverse lever with five positions, neutral, starting and running ahead and starting and running reverse, shifts the cams. All controls, ignition switch, throttle, spark control, air-starting valve and reverse lever are brought

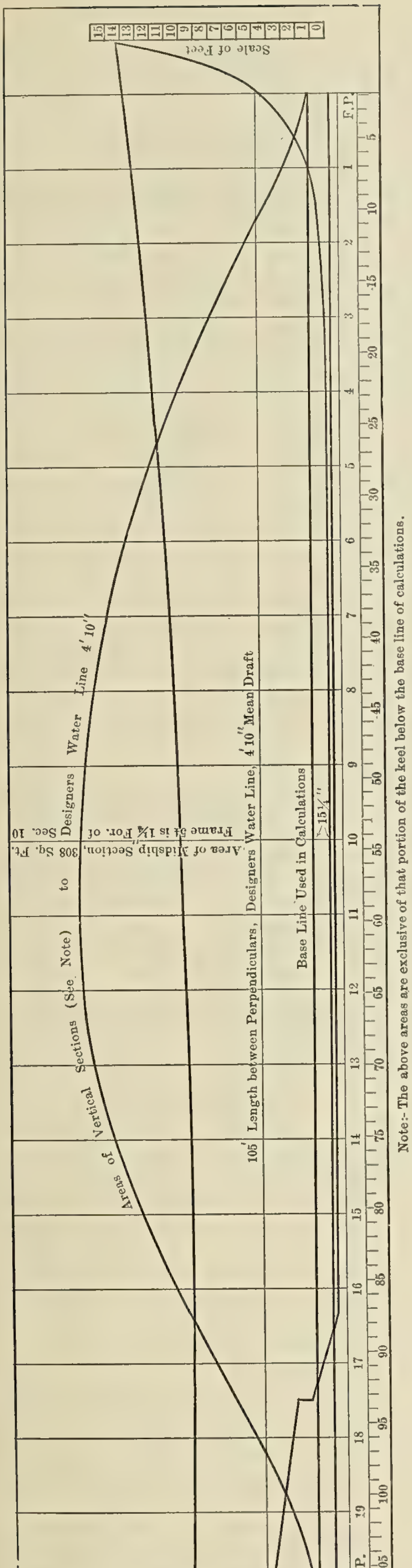


Fig. 10.—Curve of Areas of Vertical Sections

to a control station at the after end of each engine, and the bridge telegraph dial is conveniently located in view of the operator and within easy reach for answering signals.

The ease with which these vessels may be handled and the reliability of the air-starting and reversing features may be appreciated by an examination of the trial reports. The reversing test applied to all boats consisted of bringing the boat to full speed on all three engines and then ringing "full speed astern" on the wing engines and "stop" on the center. The average time for bringing the vessel to a dead stop was twenty-one seconds, and in a distance of a little over two boat lengths. Telegraphs were then rung to "full speed ahead" and the three engines were firing in from two to four seconds.

Ease and Reliability of Control

That these results are achieved in actual service with Navy crews, as well as when the engines are timed for trials and operated by experts, was demonstrated to the writer, who accompanied five chasers from Cleveland, Ohio, to the New York Navy Yard and saw them handled in the twenty-six locks of the Welland Canal and thirty-two locks of the New York State Barge Canal.

Gasoline (petrol) from the fuel tanks forward flows by gravity to the suction side of the piston type fuel pump on each engine, which discharges it directly to the special Standard design vaporizer. Any overflow from the vaporizer fuel chamber is led to a float box and by-pass leading to the pump suction, so that any excess fuel overflow from the vaporizer is immediately taken up by the pump.

Ignition is of the mechanical make-and-break type, with current supplied by magneto for ahead running and by storage battery in reverse.

Each engine has its own circulating pump, air compressor and other auxiliaries.

Auxiliary Engine

One of the hardest worked pieces of machinery in the Navy is the auxiliary engine of the 110-footer. Mounted between the two 4½-inch by 5½-inch power cylinders of the engine is the air compressor for supplying air at 250 pounds pressure for starting the main engines. Directly connected to the engine crankshaft and mounted on the bed plate is the 4½-kilowatt, 120-volt generator, which supplies all electric current used throughout the ship. A gear-driven fire and bilge pump completes the load on this set.

The generator supplies current at 120 volts direct to the motor generator set of the wireless outfit and through a charging rheostat to the two 16-cell storage batteries for lighting, ventilation blowers, searchlight and other electrical apparatus. This set was of ample size when the vessels were first brought out, but as the various submarine-detecting and other devices were perfected they were added to the equipment of the chasers to bring them to that state of efficiency that enabled them to destroy 40 percent of the Hun undersea boats officially credited to United States naval vessels. Each of these instruments increased the drain on the storage batteries, so that the auxiliary engine was soon operating night and day on charging duty.

Additional Charging Units Installed

To relieve the engine of some of this load so that it might have an occasional overhaul and be kept in condition to perform its other duties, the department authorized the installation of ¾-kilowatt Delco charging units on all submarine chasers. These units consisted of a single-cylinder, air-cooled gasoline (petrol) engine direct connected to a ¾-kilowatt, 40-volt generator. At the same time 2⅛-inch by 2½-inch Curtiss air compressors driven by ½-horsepower, 32-volt, 1,750 revolutions per minute motors were installed for emergency use.

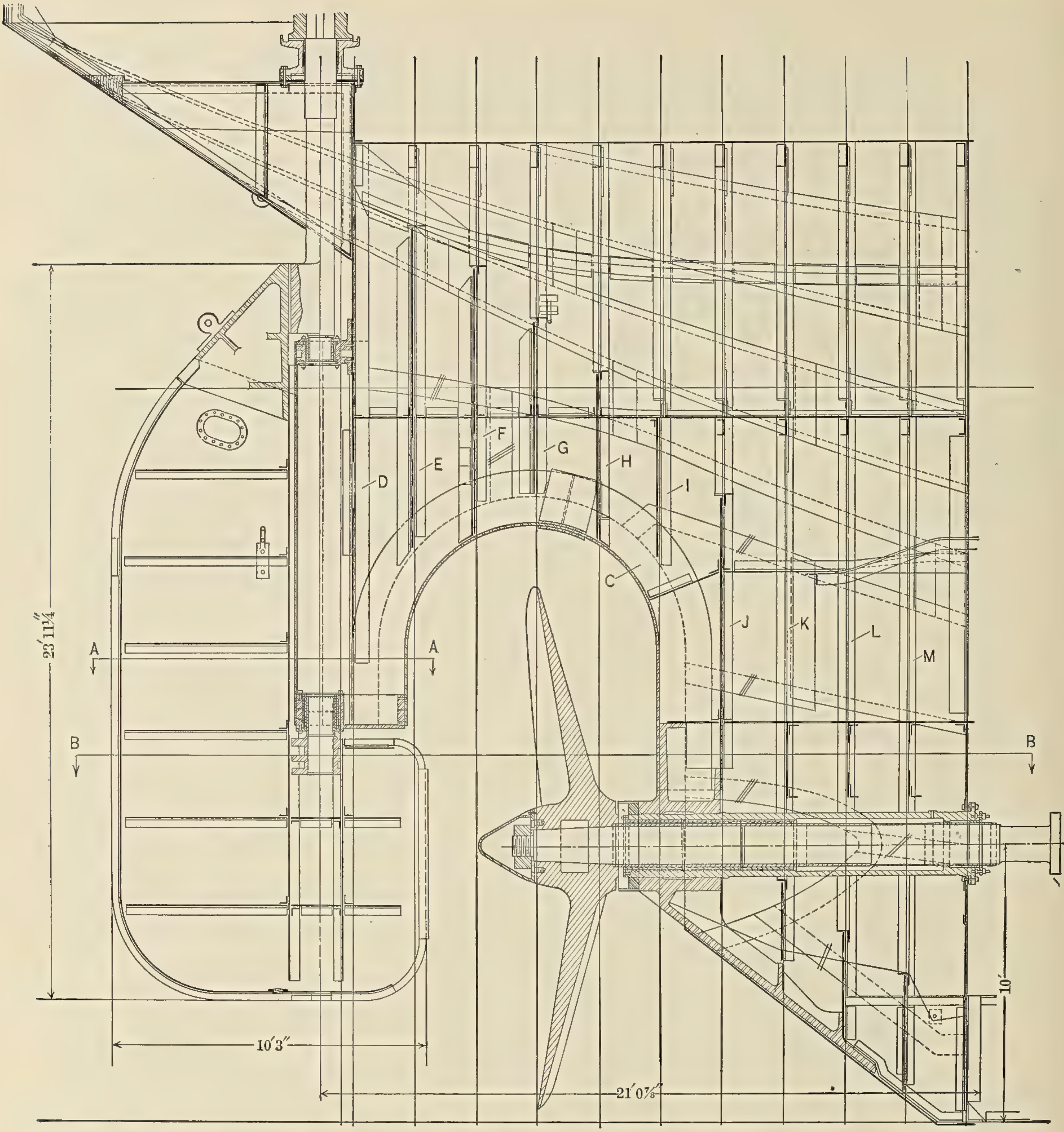
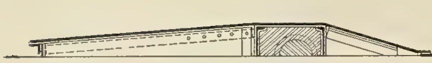


Fig. 1.—Fore and Aft Section Through Stern Frame of "Type A" Hog Island Ship

Section A-A

Fig. 2



Section at 12′ Waterline

Fig. 3

Fig. 4

Suggestion for Simplifying Construction of Fabricated Stern Frame of Hog Island Ships by Application of Electric Welding

BY WILLIAM T. BONNER

THE fabricated stern construction of the type "A" ships standardized by the American International Shipbuilding Corporation, Hog Island, Pa., offers very great opportunity for the utilization of electric welding.

Fig. 1 shows a fore-and-aft section of the stern portion of the 7,800-ton type "A" ships, showing details of framing and rudder. Fig. 2 represents a horizontal plane section of the fabricated rudder and after end of the plate arch, as on line *A-A*, while Figs. 3 and 4, as assembled, show the co-relative details of the rudder, stern section and under-rudder support at the 12-foot waterline, *B-B*.

As may be noted in Figs. 2 and 3, the hollow construction of the rudder renders it practically buoyant, or would do so were it not for the many rivets, angle bars, corner pieces and other weight members required for its assembly as a watertight riveted structure. For instance, by using 8-inch channels assembled flange inwards for the rim or edge framing members, as in Fig. 5, the weight of material would be greatly reduced and the buoyancy increased not only by the weight reduction but by increased displacement due to turning the channel flanges inward.

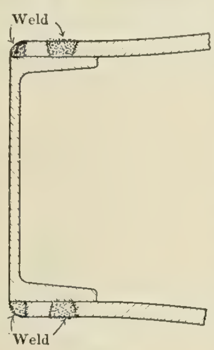


Fig. 5

Similarly, all corner pieces and other like members required for riveting could be eliminated and the frames and plates attached directly to each other by butt or fillet welds.

The greatest saving, however, would be effected by substituting electrically welded construction for the very complicated riveted framing over arch *C* in Fig. 1. Each of the frames *D* to *I*, inclusive, as also the many auxiliary braces and stiffeners, must be heated and hand-hammered to a close-up fit in place, after which they are laboriously secured by drilling and riveting. Because of the very contracted space, all of these operations are necessarily difficult and slow, and therefore expensive.

If, on the other hand, the outer shell plating should be formed and secured in its proper place, the inner framing could be easily added as a two-stage operation. Instead of using angle sections which are difficult to form, the doubling portion could be first shaped to the inner surface of the shell plating and secured by fillet welds along each edge. The second operation would consist in fitting and welding the flange portion against the doubling portion after shearing or burning the jointure edge to conform to the profile of the ship's plating outline.

By this method of construction, all pre-heating and heavy hammer shaping in place would be eliminated, perfect fits would be secured and all perforating of the skin plating would be avoided. There would be no rivets to cause leakage because of constant shear and shaft vibration, and the strength of the structure could easily be made 100 percent efficient.

In like manner it would be found desirable to extend the welded construction to include frames *J*, *K*, *L* and *M* and other like members, the assembly of which is always difficult.

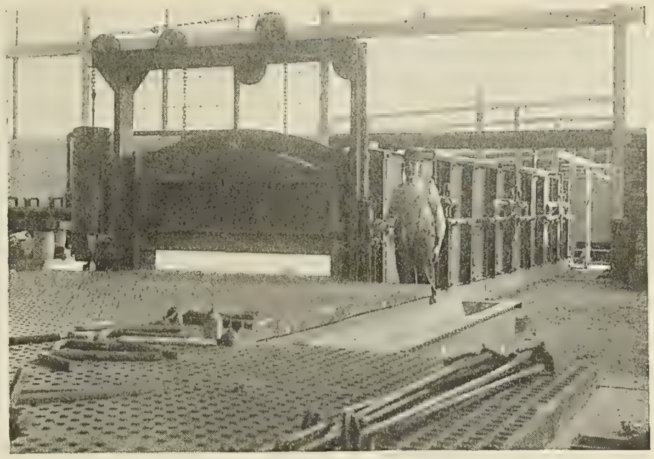


Fig. 1.—Plate and Angle Furnace, Pusey & Jones Yard, Wilmington, Del.

Gas Displaces Fuel Oil in Large Furnaces

BY WILLIAM J. HARRIS, JR.*

THE tremendous expansion of the shipbuilding industry in the United States during the past two years has offered an opportunity for many innovations which a slow, natural growth would never have provided, or which would otherwise have come only after a much longer period of time. Men formerly engaged in other lines of work have entered the shipyards and have brought new ideas with them. In some instances, no doubt, the "innovations" have proved disappointing, but in others the most gratifying results have been obtained.

The use of gas as a substitute for fuel oil in large furnaces is an example of this latter kind. There are now some four or five yards using it on an extensive scale, at least two of which use no other fuel except in the small portable rivet heaters where coke seems to have certain advantages. Gas is also doing this work with equal satisfaction, but has been objected to because of the possible danger from leaks in hose connections. The large furnaces for plate and angle bending and for heavy forgings are of sizes and have burner capacities which the average "gas man" a few years ago would have never considered attempting; and his judgment was perfectly sound, as there was no burner equipment available which had the necessary capacity and efficiency to meet fuel oil on anything like an equal cost basis.

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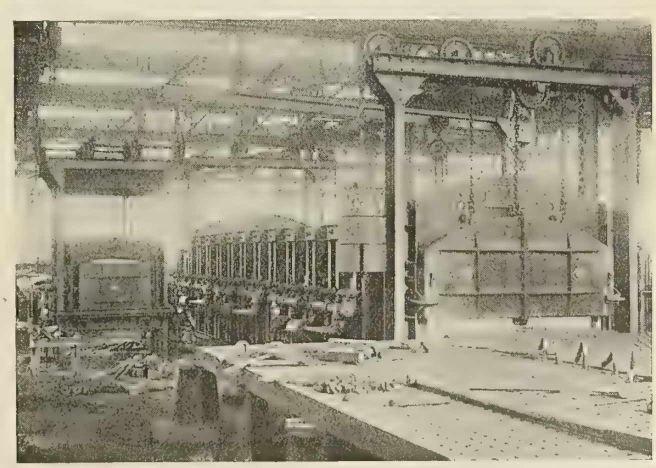


Fig. 2.—Forge Furnace and Angle Furnace, Pusey & Jones Yard, Gloucester City, N. J.

Fig. 3.—Plate and Angle Furnaces in Angle Bending Shop, Pusey & Jones Yard, Gloucester City, N. J.

The largest shipyard installation of city gas on the Atlantic seaboard is at Gloucester City, N. J., in the New Jersey and Middle Yards of the Pusey & Jones Company, where no other fuel is used for furnace work. The present equipment consists of one 5-foot 6-inch by 50-foot angle furnace, one 7-foot 6-inch by 24-foot plate furnace, one 9-foot by 20-foot plate furnace, one 4-foot by 30-inch liner furnace, one 3-foot 9-inch by 5-foot 7-inch rod furnace for a rivet-heading machine, three 3-foot by 3-foot forge furnaces, one 2-foot by 2-foot forge furnace, one 15-inch by 24-inch tool room furnace, and two rivet heaters serving "bull" riveters. The dimensions given are inside measurement.

No Air Piping or Blower Required

All of this equipment is supplied with gas at a pressure of ten pounds per square inch from a central compressor and meter house. The gas entrains sufficient air for complete combustion by means of proportioning inspirators, which are part of the burner equipment on the furnaces. Hence no air piping or blower is required, and temperature regulation is obtained by the simple adjustment of the gas valve. It is thus possible to connect a furnace to the lines at any point on the system and have it ready for operation by merely turning on the gas. The automatic proportioning feature of the burner equipment insures the maximum combustion efficiency at all times regardless of the skill of the furnace tender.

Fig. 4.—Forging Furnace Serving Steam Hammer, Pusey & Jones Yard, Gloucester City, N. J.

The other yard referred to as being completely gas equipped is that of the Pusey & Jones Company at Wilmington, Del., where there is a 6-foot 6-inch by 36-foot plate furnace, a 3-foot by 52-foot 6-inch angle furnace, and a rivet heater for the "bull" riveter.

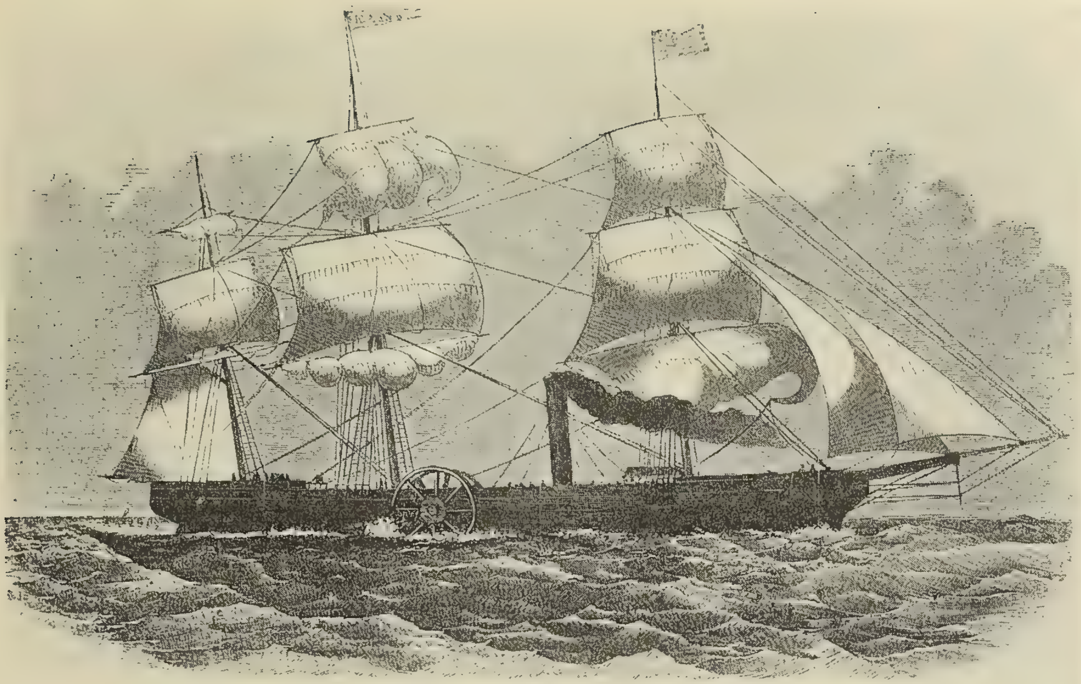
Comparative Cost of Gas and Oil

The cost of gas in comparison with fuel oil depends not only on the relative cost of the two fuels, but on the efficiency of the oil furnace against which the comparison is made. Actual tests of the oil-fired plate furnace formerly used at the Wilmington yard and the gas furnace which displaced it showed practically the same fuel cost with oil at 6 cents (0/3) per gallon and 600 British thermal unit gas at 57 cents (2/4½) per 1,000 cubic feet. This was in spite of the fact that the gas furnace is 6 feet longer than the oil furnace. Since these tests were made, the price of both fuels has advanced somewhat, but the plant engineers of both yards have stated that even though the gas may cost more than oil the difference is more than compensated for by the many advantages, such as freedom from smoke and fumes, no oil storage or handling, reliability of supply, fuel being paid for after use instead of before, uniformity of temperature distribution and ease of control. The satisfaction given by the gas furnaces is evidenced by the fact that additions have been made in both the plants mentioned, which almost equaled the original installation in size.

The accompanying illustrations are, as indicated by the titles, of the furnaces mentioned above, which were designed and installed complete by The Surface Combustion Company of New York City.

Other Installations

Plate and angle furnaces (the latter being 60 feet long) of similar design using city gas have been supplied by the same company to the Norway Pacific Construction & Drydock Company at Seattle, Wash., and to John Eichleay, Jr., Company and the McClintic Marshall Construction Company at Pittsburgh, Pa., for operation on natural gas.



American Steamer *Savannah*, Built in 1819, the First Steamship to Cross the Atlantic

Centenary of Transatlantic Steam Navigation

History of the First Steamship to Cross the Atlantic—Famous Voyage of the American Steamer Savannah to Liverpool in 1819

BY F. B. C. BRADLEE

THE honor of first navigating the sea with a steamer belongs to Colonel John Stevens, of New York, and the credit is not diminshed by the fact that he was forced to it by circumstances beyond his control. Having built the steamboat *Phœnix,* he was prevented from navigating the Hudson, because at that time (1808) Fulton and Livingston had a monopoly of this river, and accordingly the *Phœnix* was sent around by sea to the Delaware River. England in those days was very active and ambitious in the new enterprise, yet it was nine years later before she ventured on sea voyages. In 1817 the steamer *Caledonia* first crossed the Channel on her way to Holland.

Transatlantic steam navigation was long discussed before anyone combining sufficient skill with courage and a spirit of adventure made the bold attempt.

The *Times* (of London, England), in the issue of May 11, 1819, thus announces the expected event:

"Great Experiment.—A new steam vessel of 300 tons has been built at New York for the express purpose of carrying passengers across the Atlantic. She is to come to Liverpool direct."

On the very day that this brief notice appeared, the vessel referred to was visited by the President of the United States and made a short trial trip previous to her departure on a hazardous voyage.

New York Shipbuilders Built the Savannah

This steamer, named the *Savannah,* the first that crossed any of the oceans, was built at Corlear's Hook, New York City, by Crockett and Fickett. The New York custom house records give her measurements as follows: Tonnage, 319; length, 98½ feet; beam, 26 feet; depth of hold, 14½ feet. The *Savannah* was equipped with an inclined, direct-acting, low-pressure engine of 90 horsepower. It had a single 40-inch cylinder; the machinery was built by Stephen Vail at Morristown, N. J., and the boiler by Daniel Dod at Elizabeth, N. J.

Originally intended for a New York and Havre packet, the *Savannah* was purchased before completion by Scarborough and Isaacs, merchants of Savannah. She was launched August 22, 1818. She could carry only seventy-five tons of coal and twenty-five cords of wood. Commanded by Captain Moses Rogers, and navigated by Stevens Rogers, both of New London, Conn., the *Savannah* sailed from the city of Savannah, Ga., on May 25, 1819, bound for St. Petersburg via Liverpool. She reached the latter port on June 20, having used steam eighty hours out of the twenty-six days, and thus demonstrated the feasibility of transatlantic steam navigation.

Original Log-Book of the Savannah the Property of the National Museum

The original log-book of the *Savannah,* containing the daily record of her memorable voyage, is in possession of the United States National Museum.

There are no original pictures extant of the *Savannah.* A crude lithograph is the basis of all the pictures published of this historic vessel and is here reproduced. It is to some degree faulty, but is the best that can be had. Some authorities, notably the late S. W. Stanton, maintained that her paddle wheels were not open, but had canvas paddle boxes. There exists an oil painting showing the *Savannah* so fitted. The question, however, is doubtful. On one page of the Log occurs the statement: "We took the wheels in on deck in 30 minutes." This statement refers to the fact that the steamer was so constructed that

in case of boisterous weather her paddle wheels could be brought in on deck.

According to the Log the steamer reached Savannah from New York on April 6, having used steam four days. It remained there eight days and then "got steam up and started for Charleston," which was reached next day. The vessel lay at Charleston until April 30, when it returned with steam to Savannah.

The *Savannah* remained twenty-three days at the city of the same name, and on May 11 was visited by the President of the United States.

The *Savannah* was fitted with accommodations for passengers, and, although the Savannah *Georgian* advertised her departure some days ahead, no venturesome travelers presented themselves. Crossing the Western ocean by steam was then too much in the nature of an experiment.

The Historic Voyage Across the Atlantic

On May 22, Captain Rogers "got steam up and at 9 A. M. started" on the transatlantic voyage. Nothing of much interest is detailed in the daily records of the log-book, which are, on the whole, rather monotonous. On June 2 they "stopped the Wheels to clean the clinkers out of the furnice, a hevy head sea, at 6 P. M. started Wheels again; at 2 A. M. took in the Wheels."

Land was sighted on June 16, being the coast of Ireland, and on the 17th the *Savannah* "was boarded by the King's Cutter *Kite,* Lieutenant John Bowie."

The log-book here, as elsewhere, is sternly brief, but fortunately we have in Stevens Rogers' own words a fuller account of the amusing circumstances connected with the boarding by the King's cutter. He said, in a communication to the New London (Connecticut) *Gazette*: "She [the steamer] was seen from the telegraph station at Cape Clear, on the southern coast of Ireland, and reported as a ship on fire. The Admiral, who lay in the Cove of Cork, dispatched one of the King's cutters to her relief. But great was their wonder at their inability, with all sail in a fast vessel, to come up with a ship under bare poles. After several shots were fired from the cutter, the engine was stopped, and the surprise of her crew at the mistake they had made, as well as their curiosity to see the singular Yankee craft, can be easily imagined. They asked permission to go on board, and were much gratified by the inspection of this naval novelty."

Two days later (June 20) they "shipped the wheels and furled the sails and run into the River Murcer, and at 6 P. M. come to anchor off Liverpool with the small bower anchor."

These simple words are all that were thought necessary to record the successful termination of the daring venture: not a word of boasting, of congratulation, nor even of thankfulness, does this man of deeds place on record. Fortunately, we have details of the manner in which the steamer was received in the account given by Stevens Rogers already alluded to. He says: "On approaching Liverpool hundreds of people came off in boats to see her. She was compelled to lay outside the bar till the tide should serve for her to go in.

"On approaching the city, the shipping, piers, and roofs of houses were thronged with persons cheering the adventurous craft. Several naval officers, noblemen and merchants from London came down to visit her, and were very curious to ascertain her speed, destination and other particulars."

During the sojourn of the *Savannah* at Liverpool the British public regarded her with suspicion, and the newspapers of the day suggested the idea that "this steam operation may in some manner be connected with the ambitious views of the United States." One journal, recalling the fact that Jerome Bonaparte had offered a large reward to anyone who would succeed in rescuing his brother Napoleon from St. Helena, surmised that the *Savannah* had this undertaking in view.

The steamer remained twenty-five days at Liverpool and sailed for St. Petersburg on July 23, "getting under way with Steam," and "a large fleet of Vessels in company." Captain Rogers touched en route at Copenhagen, where his vessel excited great curiosity, and also at Stockholm, where she was visited by the royal family, or, in the homely language of the log-book, "His royal highness Oscar Prince of Sweden and Norway come on board." (August 28.) While at Stockholm, we find this entry: "Mr. Huse [Christopher Hughes] the American minister and Lady and all the Furran Minersters and their Laydes at Stockholm come on board"—and at Mr. Hughes' invitation made an excursion among the neighboring islands.

On September 5 the steamer left Stockholm, with Lord Lynedock, of England, who was then on a tour through the north of Europe, as a distinguished passenger. On the 9th she reached Cronstadt, having used steam the whole passage, and a few days later she arrived at St. Petersburg. Here she was visited, at the invitation of our ambassador at that court, by the Russian Lord High Admiral, Marcus de Travys, and other distinguished military and naval officers, who also tested her superior qualities by a trip to Cronstadt.

The *Savannah* lingered at St. Petersburg until October 10 and then set sail on her homeward voyage, "in company with about 80 sail of Shiping." She arrived at Savannah Tuesday, November 30. Shortly after, the steamer was taken to the navy yard at Washington. The object of this visit to the national capital was, in the words of another, "to fix her name and exploits in the minds of prominent men from all parts of the United States, in order to lay a foundation for the defense and maintenance of our claim to that distinction which this craft and her daring commander had unitedly wrought out for our nation upon the mighty deep."

Subsequent History of the Savannah

The subsequent history of the *Savannah* can be told in a few words. On account of the great fire in Savannah, her owners were compelled to sell her, the engine was removed and she was purchased to run as a packet between that place and New York, whither she was bound, under charge of Captain Nathaniel Holdredge, when she was lost on the south side of Long Island in November, 1821.

This sketch of the voyage of the *Savannah,* with the extracts from the log-book, establishes beyond a doubt that America deserves the credit of having been the first to apply steam machinery to the navigation of the Atlantic. Many articles on the early history of steam navigation have been written which ignore the claims of the *Savannah* and her enterprising captain.

In fact, when the steamers *Sirius* and *Great Western* arrived in New York Harbor April 23, 1838, twenty years after the exploit of the *Savannah,* they were received with extravagant manifestations of delight; and in an editorial in the *New York Express* of April 24, reference is made to the "unusual joy and excitement in the city, it being almost universally considered as the beginning of a new era in the history of Atlantic navigation." The achievement of the *Savannah* was forgotten, her skillful captain no longer lived to claim his rights, but patriotic citizens protested in the public press against losing sight of the just claims of America.

Fig. 1.—The Twenty-Eight Shipways at the Newark Bay Yard of the Submarine Boat Corporation

Noteworthy Achievement of the Submarine Boat Corporation

THE Newark Bay shipyard of the Submarine Boat Corporation launched the following ships during the month of March and thereby established a record for the launching of cargo ships: *Wisconsin Bridge, Milwaukee Bridge, Opequan, Bound Brook, Knoxville, Louisville Bridge, Anniston, Chattanooga, Montgomery.*

These vessels are of the "new American type" with a deadweight capacity of 5,500 tons. They are equipped with Westinghouse geared turbines and have a speed of 10½ knots. Steam is furnished by two Babcock & Wilcox marine type oil-fired watertube boilers.

Approximately 27 steel mills, 56 fabricating plants and 200 foundries, machine, pipe, joinery and equipment shops are engaged in the production of the parts composing the ships assembled at Newark Bay.

On September 14, 1917, when the submarine Boat Corporation signed its contract with the United States Shipping Board Emergency Fleet Corporation, the site of the Newark Bay shipyard was a barren strip of Jersey meadow land, and the management of the Submarine Boat Corporation faced the stupendous task of building the plant, arranging for the manufacture of the plates and shapes, propelling machinery and auxiliaries and, when the ship material began to arrive, of constructing the ships.

In spite of all the difficulties encountered, the Newark Bay shipyard to March 31, 1919, had launched 35 ships, representing a deadweight tonnage of 192,500. A large number of the ships have already received their trials and are awaiting allocation to the operating companies.

Fig. 2.—Thirteen Vessels Nearing Completion at the Fitting-Out Berth of the Submarine Boat Corporation

Fig. 1.—The *Schenectady* Afloat

Hog Island Turbine-Driven Cargo Vessel Christened Schenectady

ONE of the geared turbine-driven cargo vessels, which was launched on March 15 by the American International Shipbuilding Corporation at Hog Island, Pa., was christened *Schenectady* in honor of the industrial city where the propelling machinery of the vessel was built. The sponsor was Miss Miriam Rohrer, daughter of A. L. Rohrer, electrical superintendent of the General Electric Company, builders of the turbine and reduction gears installed on the vessel.

The vessel is designed for a deadweight capacity of 7,500 tons, the total displacement loaded being estimated at 11,200 tons. According to estimates, the weight of the steel hull is 3,100 tons; of the machinery with water, 460 tons; of the wood and equipment, 140 tons, and the total weight of the ship, light, 3,700 tons. There are 380,000 cubic feet of cargo space, and the gross tonnage is estimated at 5,400.

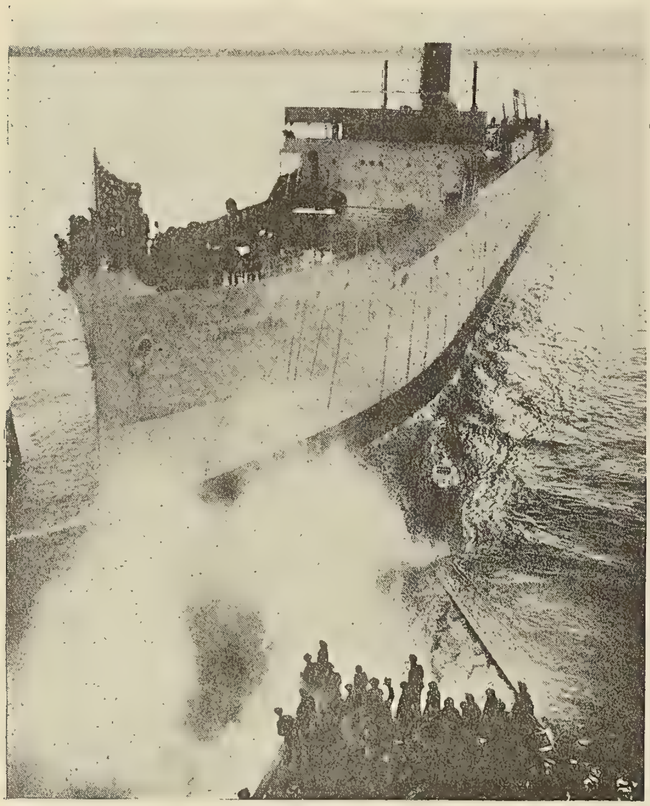


Fig. 2.—Launching the *Schenectady*

Propulsion is by single screw, driven by a General Electric marine type geared turbine of 2,500 shaft horsepower, supplied with steam at 200 pounds per square inch pressure from three oil-fired watertube boilers, with a total heating surface of 9,075 square feet, operated under natural draft.

The main turbine is designed to operate at 3,234 revolutions per minute, driving the main propeller shaft through a double-helical, double-reduction gear at a speed of 90 revolutions per minute. With dry saturated steam at 180 pounds gage pressure at the throttle, a 28-inch vacuum referred to a 30-inch barometer in the condenser, the steam consumption of the turbine, when developing its rated horsepower, is guaranteed not to exceed 12 pounds per shaft horsepower. The vessel has a fuel capacity of about 1,100 tons and, with an estimated fuel consumption of 29½ tons per twenty-four hours, will have a cruising radius of over 10,000 nautical miles.

The turbine is so arranged that the ahead turbine and the astern turbine are carried on the one shaft and in the same casing and consists of five stages for the forward turbine and two stages for the reversing unit. The maneuvering is done by hand and is interlocked in such a manner that it is impossible to open the valve for the astern turbine if the valve for the ahead turbine is not closed, or vice versa.

The turbine and the high-speed pinion are designed to operate at a full power speed of 3,234 revolutions per minute when supplied with steam at 200 pounds pressure and exhausting into 28.5 inches of vacuum.

The high-speed gears and the low-speed pinions have a speed of 425 revolutions per minute, and for the low-speed element the speed is further reduced to 90 revolutions per minute. The total speed reduction from the turbine speed of 3,234 revolutions per minute to the low-speed gear or the propeller speed of 90 revolutions per minute gives a ratio of 35.9 to 1.

The General Electric turbine and the one plane, flexible type, speed reduction gear form a single power unit.

The gear is built up of a number of plates machined to a form which gives them the desired degree of lateral flexibility. These plates are put together, engaging solidly at the hub and also engaging on a narrow edge at the periphery. When so built together they form a solid cylinder which can be spirally cut in the ordinary manner. After cutting, the edge engagements are relieved with a small dividing tool, so that each disk operates independently and is free to deflect laterally under the side pressure which results from its diagonal engagement with the pinion. The parts are so proportioned that this lateral deflection can at no time involve fiber strains which could

Fig. 3.—Viewed from Any Angle, Little Fault Can Be Found With the Simplified Lines of the Fabricated Hull

possibly cause destructive fatigue and result in failure.

A very small amount of this lateral deflection is sufficient to afford the desired distribution of load, and this amount can easily be given without approaching dangerous periodic strains.

Other electrical equipment on these boats consists of two 15-kilowatt, steam-driven standard General Electric lighting sets, a blinker light controller and an 18-inch direct-current emergency fleet searchlight with pilot house control.

The hull of the vessel is constructed on the transverse system and is subdivided into nine watertight compartments by eight transverse watertight bulkheads, all of which extend to the upper deck. There are four cargo holds, served by five hatches in the upper and second decks and one hatch in the bridge deck.

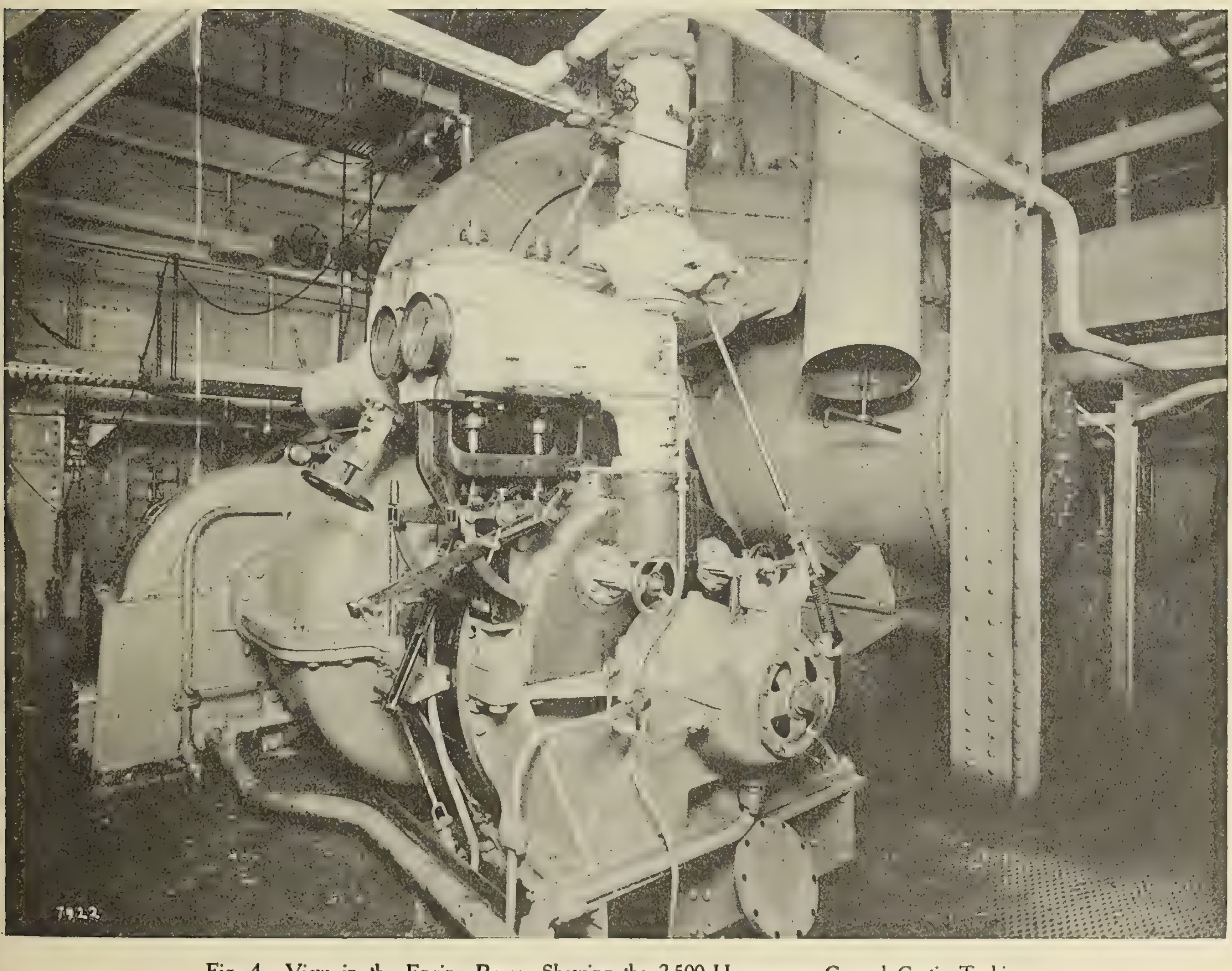


Fig. 4.—View in the Engine Room, Showing the 2,500-Horsepower Geared Curtis Turbine

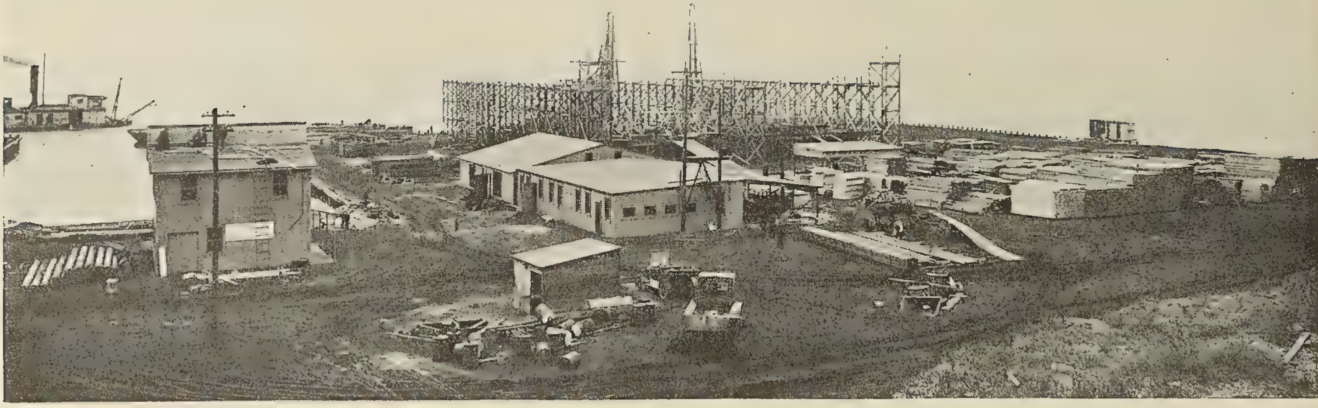


Fig. 1.—General View of the Yard and Shipways of the Liberty Ship Building & Transportation Company

New Concrete Shipyard on Lake Erie

Plant of the Liberty Ship Building & Transportation Company at Cleveland—Method of Constructing Concrete Car Floats

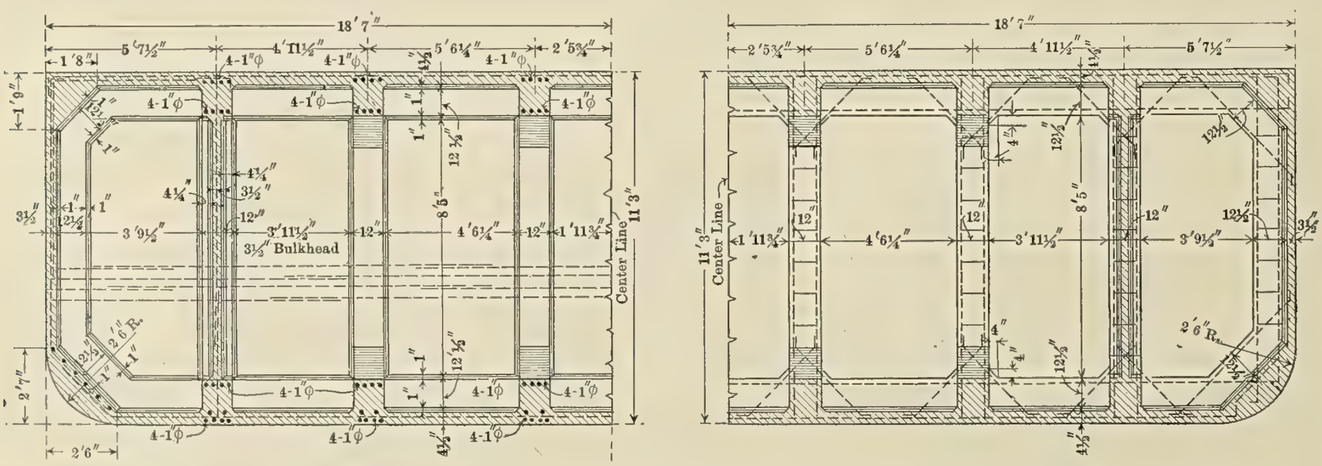
THE yard and berths of the Liberty Ship Building & Transportation Company cover about six and three-quarter acres, with a waterfront of 395 feet at the foot of East 40th street on Lake Erie, Cleveland, Ohio. The yard is entirely on made ground. Timber bulkheads were built along three sides of the yard and filling up to lake level was placed back of same with a hydraulic dredge. A top fill of about four feet was made with excavated material from the bank at the land end of the yard. A top fill of cinders 12 inches thick was spread over the entire area and rolled to grade. The general yard level is five feet above mean lake level.

With this construction, a waterfront on three sides of the yard was obtained. Along the West side, where the water is 16 feet deep, a fitting-out slip 100 feet wide and 325 feet long was built. At present only two berths covering about one-eighth of the entire area of the yard have been built. These are constructed in a substantial and permanent manner and can accommodate the fabrication of large as well as small craft in "end-on" position.

The foundation of the berths is hard wood piling ranging in length from 50 to 60 feet spaced at approximately 5-foot centers over the entire area. The length of a berth is 280 feet and the width 52 feet. The piles are capped with continuous 12-inch by 12-inch timbers across the width of the berths, the cut-off being made so as to give a declivity of 6 percent to the standing ways.

On top of the pile caps, 12-inch by 12-inch yellow pine way blocks were placed to provide for the proper distribution of the weight of the vessel during launching. The entire timber structure was braced both longitudinally and transversely with 3-inch by 10-inch bracing bolted to the pile caps.

The standing ways for the concrete boats now being built were laid down before the forms were placed. Each way is built up of two 12-inch by 12-inch oak timbers bolted together and drifted to the way blocks on top of the caps. A 4-inch by 12-inch oak ribband is bolted on the outboard side to act as a guide or flange for the sliding ways. These ground ways are 26 feet on centers, which brings the make-up block on top of the sliding ways directly beneath a longitudinal bulkhead of the concrete boat now being built. At the dock line the top of the standing ways is at lake level, while at the upper end of the berth



Section Facing Bulkhead

Section at Frame

Fig. 2.—Midship Section of Reinforced Concrete Car Float

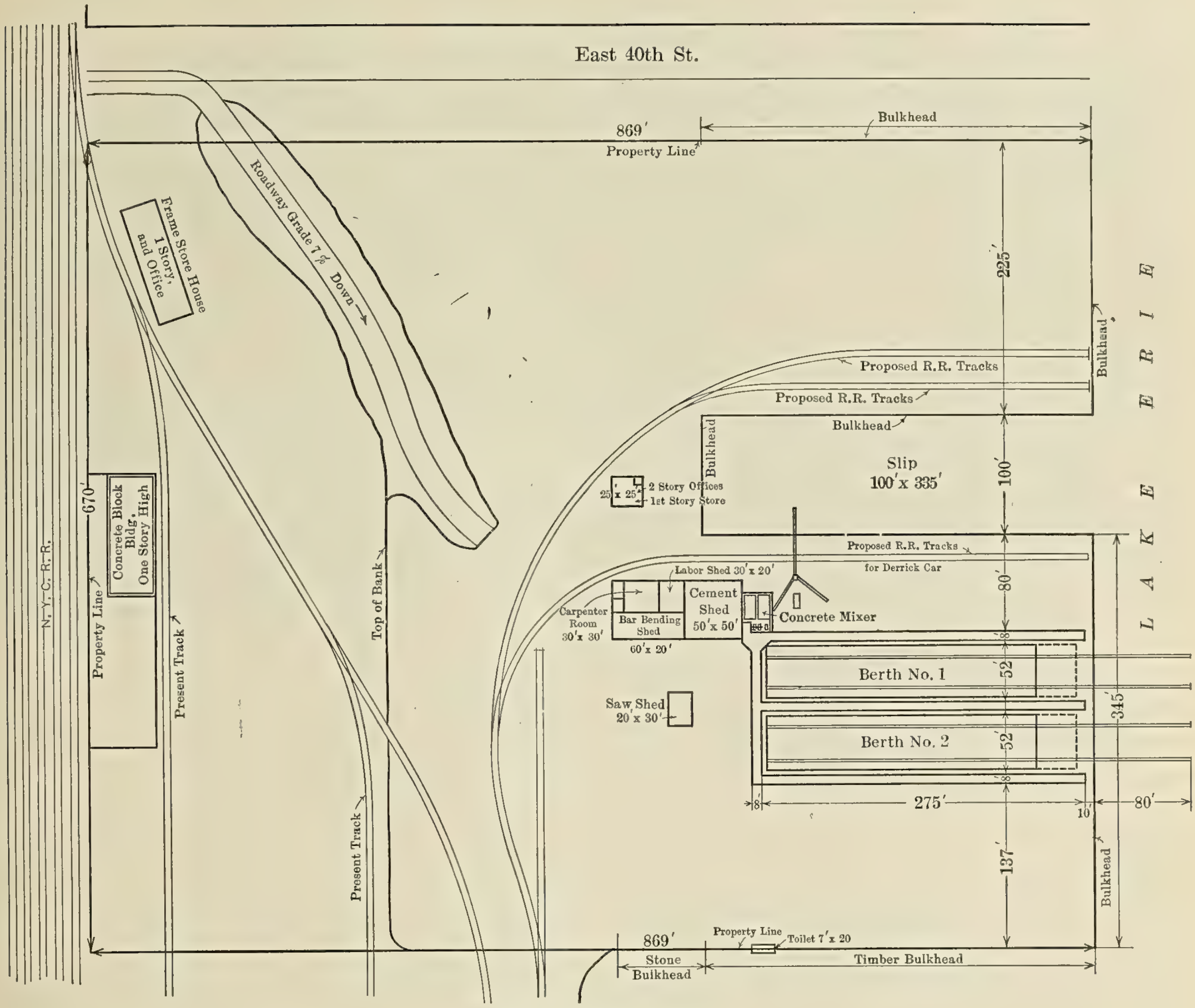


Fig. 3.—Layout of the Yard

they are 16.8 feet above lake level, or 11.8 feet above the general yard level.

On three sides of the berths are timber runways 8 feet wide built on top of timber bents spaced 8-foot centers. The bents are made of 6-inch by 6-inch posts braced with 2-inch by 8-inch timbers bolted to same. The runway itself is composed of removable panels which can be placed at a higher or lower level, according to depth of the vessel being built. Their present level is approximately two feet higher than the bow or upper end of the boat in the berths, which height is 28 feet above the yard level.

These runways, while of a rather unusual type for a shipyard, serve several purposes. They afford a substantial and unmovable frame for bracing hull forms. They will form a framework for future covering of the berths, both for side sheathing and supports for roof trusses and any traveling cranes installed. They are also used for conveying concrete from an elevator to chutes along the side of the vessel being built, as described elsewhere.

Extending 80 feet into the lake are the launching ways, built in substantially the same manner as was used in constructing the berths, with the exception that the ways themselves are bolted to pile foundations instead of being

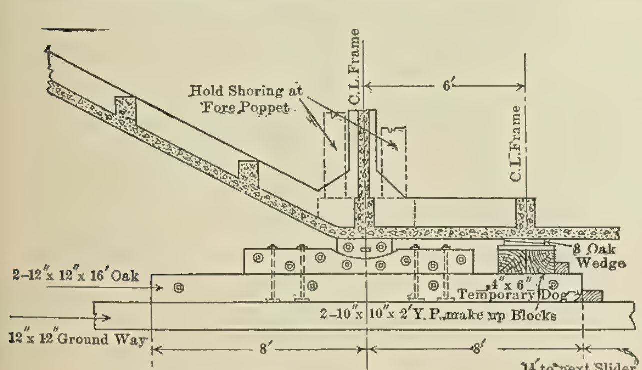


Fig. 4.—Launching Way at Fore Poppet

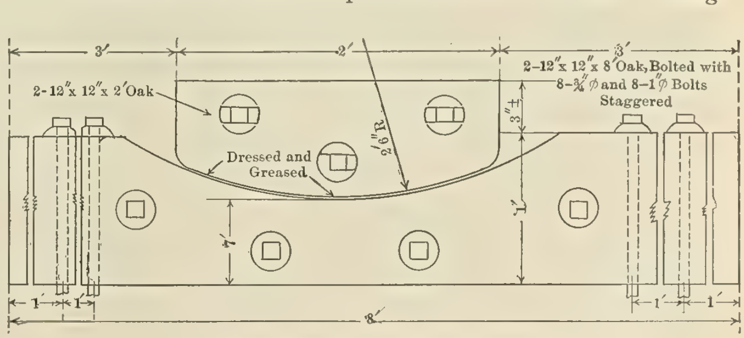


Fig. 5.—Detail of Fore Poppet

Fig. 6.—Building Berth

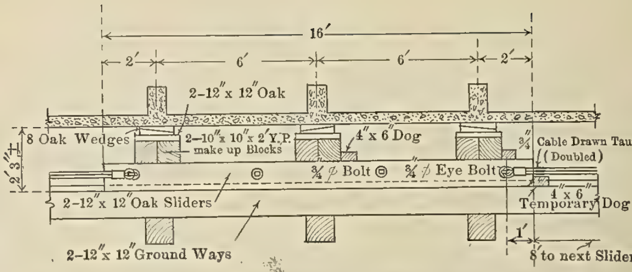


Fig. 7.—Longitudinal Section of Portion of Launching Way

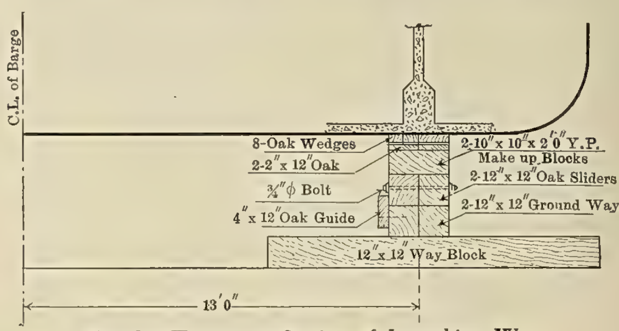


Fig. 8.—Transverse Section of Launching Way

fastened with drift pins. There is 4.8 feet of water over the top at the end of the ways, with a total depth of 15 feet of water at this point. These depths are adequate for launching the type of craft now being built.

Access to the yard is obtained by a 20-foot driveway laid on a 7½ percent grade from East 40th street. A railroad switch from the main line of the New York Central Railroad is under construction, and when completed will afford excellent switching facilities, as direct connection can be made to any part of the yard.

The yard buildings consist of laborers' and carpenters' sheds, a cement house, bar-bending shed, and a large carpenter shop with circular saws and other wood-working tools. There is also a concrete mixing plant, including a one-half cubic yard steam-driven Koehring mixer, and bucket elevator. A large boiler plant furnishes steam for mixing and heating concrete materials. A smaller steam boiler runs the concrete hoist. A small air compressor furnishes air for drilling, cleaning forms, cement gun work, vibrating forms during placing of concrete, etc.

The fabrication of the concrete car floats now being built at this yard proceeds as follows: The bottom and outside forms are erected and faired. The reinforcing steel is then put in place supported on small concrete blocks resting on bottom forms. All steel is securely wired or otherwise held rigidly in place. Inside forms are next erected, and when thoroughly braced the concrete is poured. Inside forms are supported by additional concrete blocks resting on reinforcing steel. Concrete is dumped from the mixer into an elevator bucket and raised to the head hopper at the runway level. From this hopper it is conveyed in 6-cubic-foot buggies along the runways and emptied into chutes leading to the point of deposit. The pouring of the concrete is made in three units: First, bottom skin, keelsons and frames and outside skin and frames; second, bulkheads; third, stanchions, deck beams, girders and deck slabs.

The removal of forms takes place as soon as the con-

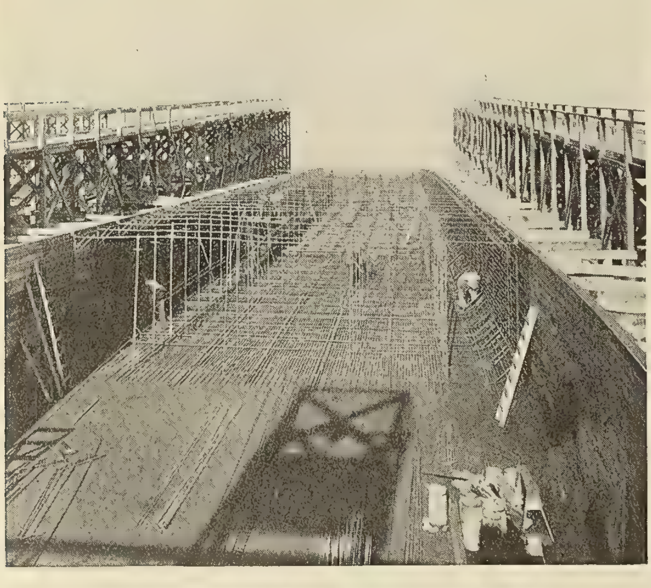


Fig. 9.—Outside Form Erected and Faired

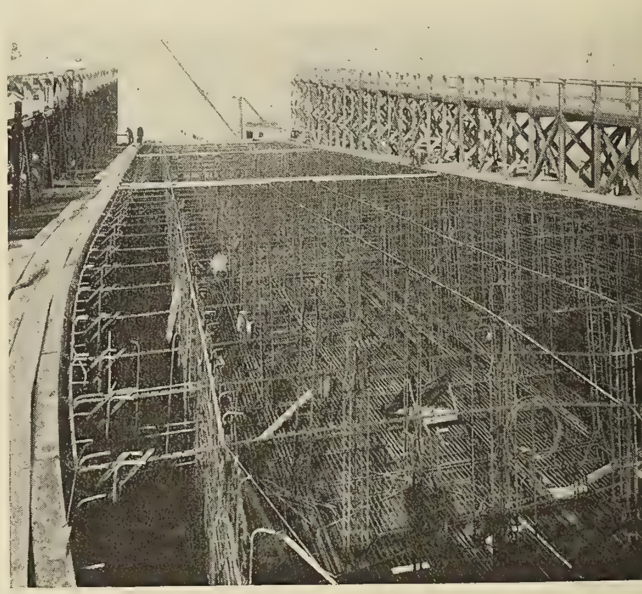


Fig. 10.—Reinforcing Steel Put in Place

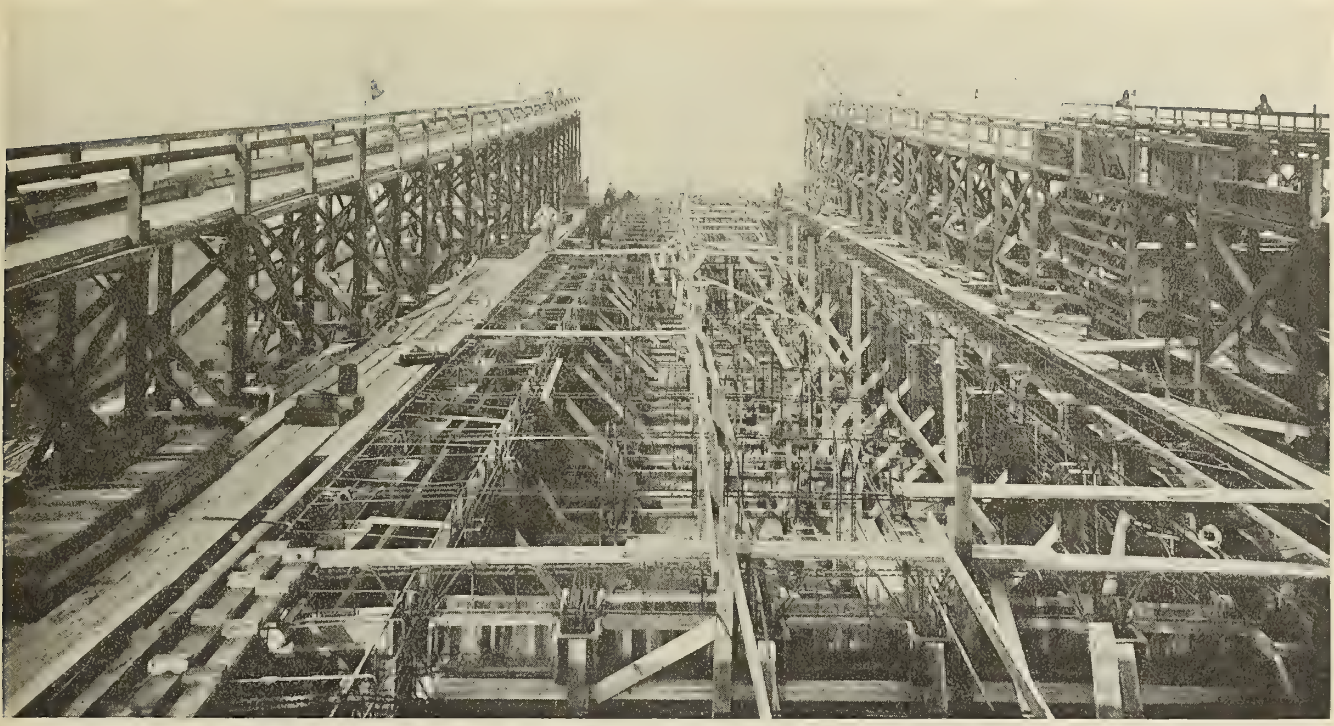


Fig. 11.—Erecting Inside Forms

crete is sufficiently mature, and, as all form work is made in panels, it is the intention to use them at least three times. An interesting detail of construction is the removal of the outside bottom forms for the waterproofing of the concrete hull and the placing of sliding ways underneath. The timbers supporting the bottom forms are in four units placed athwartships. The outboard units are removed first and the side and bilge forms slid back from the concrete about six feet. The outboard panel of the bottom forms is also dropped from the concrete bottom. Waterproofing is then applied to the exposed surface and temporary blocking is placed just inside the bilge curve.

A third unit of supporting timbers is next removed from the bottom and the forms lowered from the concrete. This surface is then waterproofed as before and cribbing and blocking is placed under this part of the boat after waterproofing is completed.

The fourth unit of supporting timbers and bottom forms is finally removed and the bottom treated as before. The entire craft is now carried on blocks and cribs.

The ground ways are next prepared for launching by scraping and coating with a mixture of tallow and soft soap. Sliding ways are then placed in position and make-up blocking set between the concrete hull and sliding ways. All of the sliders are securely dogged to the ground ways before wedging up is started.

When everything is ready for the launching, the weight of the boat is transferred from the cribbing and blocking to the sliding ways by means of lowering and raising wedges. The dogs are then removed from the sliding

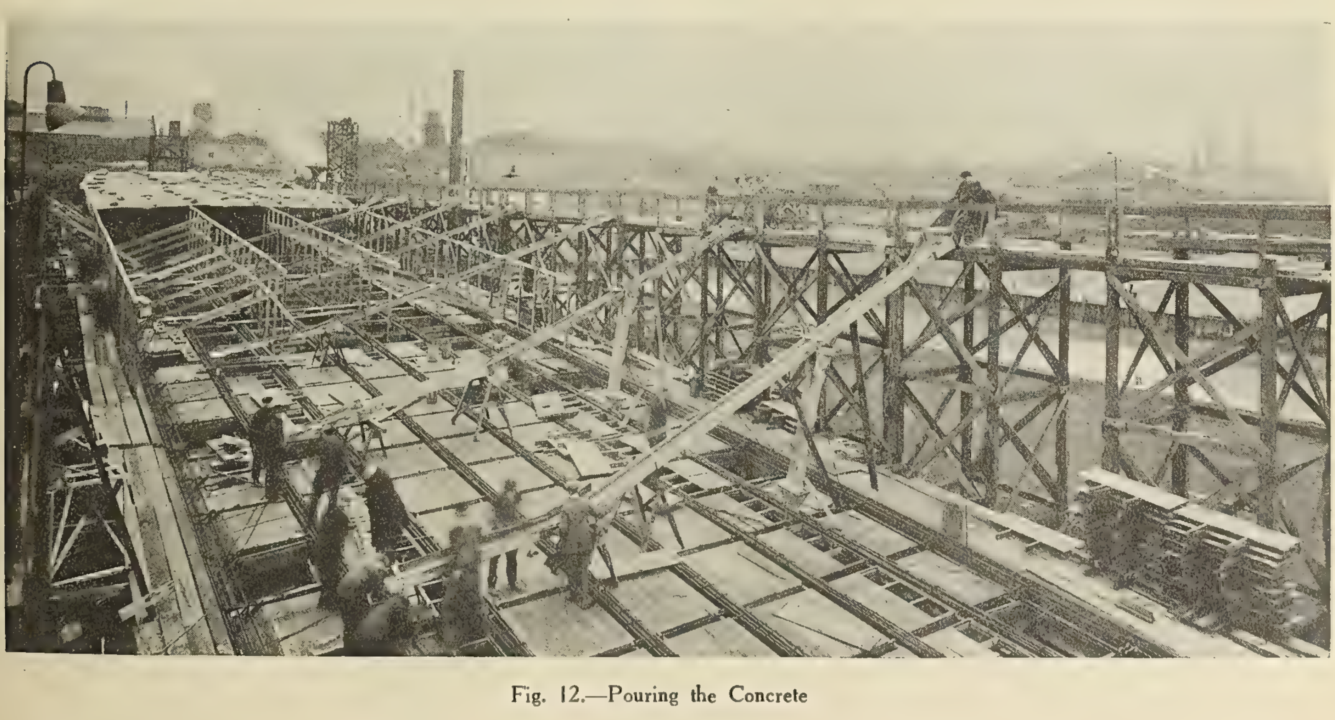


Fig. 12.—Pouring the Concrete

Fig. 13.—Forms Removed After Concrete Has Set

ways and the anchor ropes attached to the last slider cut. Hydraulic jacks were placed back of the last slider, but were not needed in launching the first two concrete car floats.

In investigating the launching conditions which obtain in the type of concrete craft being built at this yard, it developed that a very great concentrated weight was placed on the last slider (or fore poppet) block at the moment of uplift or when the hull becomes buoyant. In order to overcome the application of this concentrated weight on a pivot point and to prevent a puncture of the concrete shell, a special rocker block or journal was designed and placed under the bottom at the fore poppet. This journal was so designed that as the opposite end of the craft started to lift, the journal block rotated and the concentrated weight was distributed over the area of the block instead of at the pivot point.

Six concrete car floats are now being built at this yard. These are 265 feet long, 37 feet 2 inches beam, and 11 feet 3 inches depth. Their displacement is 1,500 tons light.

London's Tribute to the Mercantile Marine.—On July 19 of this year London is to have an opportunity of paying tribute to the British mercantile marine for its magnificent services during the war—services which kept the British nation from starvation and in other ways aided in the victory. Every shipowner in Great Britain is to be invited to take part, and the ceremony will take place on the historic Thames Embankment.

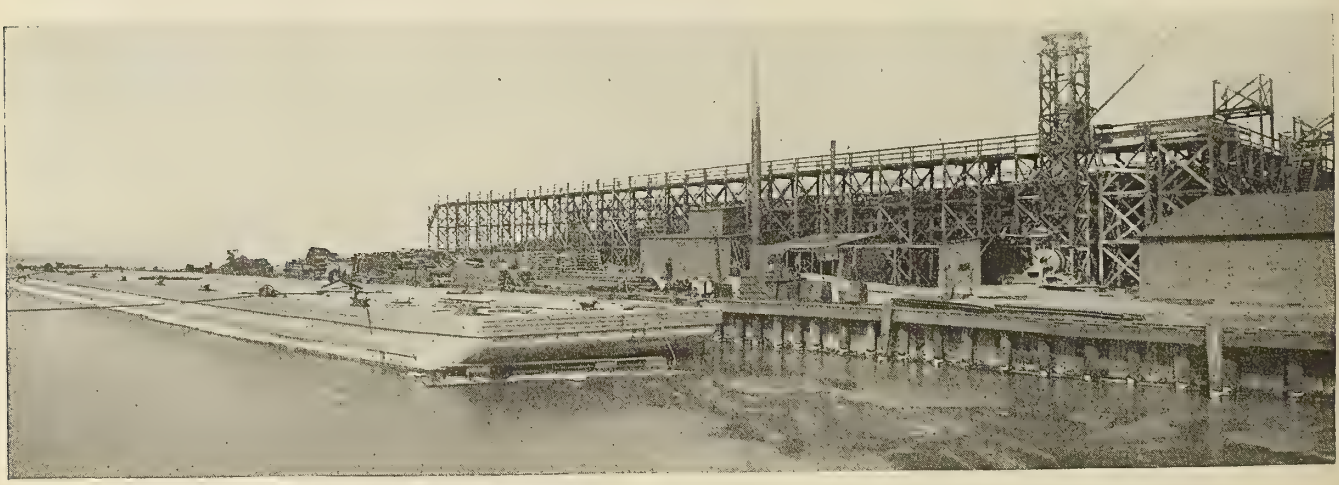


Fig. 14.—Concrete Car Float, 265 Feet Long, 37 Feet 2 Inches Beam, 11 Feet 3 Inches Depth, After Launching

On the Great Cost of High Speed

Analysis of Relative Costs in Power for Moderate Increases in Speed in Slow- and High-Speed Vessels

BY SIDNEY GRAVES KOON, M. M. E.

THE continual demand for higher speeds of travel, both on land and on sea, has produced a pressure upon the designers of the media of travel which is by no means apparent to the casual observer. In the case of steamships, it is far from an insuperable task to install machinery which will produce any speed yet demanded; but when it comes to the concurrent problem of providing, along with that machinery, enough fuel to operate it at its maximum power for a distance of three thousand miles, and of allowing at the same time for enough carrying capacity for cargo and passengers to make the voyage remunerative, the difficulty of the situation sometimes becomes very great. The importance of the subject would seem to justify a little discussion of the most salient feature in it—the cost in power for the speed required.

During the height of the submarine raiding of commerce in 1917, much criticism was directed at the so-called "standard" designs of the Emergency Fleet Corporation, due to the fact that the speed provided was only 10.5 to 11 knots (actually less than that at sea), while the submerged speed of the more modern of the German submarine was supposed to be a little greater than that. A speed of 12 knots or better was asked of the freighters, that they might have that much better chance of eluding their slinking foes, and immunity had been shown to increase about as the square of the speed.

But the power cost of that increase in speed was shown to be fully 50 percent, or an increase from 2,500 to 3,750 horsepower. At prevailing machinery weights, this represented about 200 tons. To this must be added the extra fuel for the more powerful engines—some 200 tons more; a total added weight of 450 tons when we include the extra feed water, lubricants and stores. Now, this calculation is based on a ship with deadweight capacity of 8,800 tons, or cargo capacity of perhaps 7,500 tons. The loss in carrying capacity, therefore, would have been about 6 percent—a very serious item, when the demand for capacity was as insistent as it was at that time.

This example of the cost of a really moderate increase in speed in a region of low speeds is but a trifle compared with a similar increase in the speed of a ship which is already of high speed, as a passenger ship or cruiser. A particularly good case in point is found in a study of the trial reports of a group of four very successful armored cruisers built some years ago for the British Navy. These ships carried the speed up to a point fully abreast of the most stringent demands for transatlantic practice, if we except such a flyer as the *Mauretania*. They were the *Drake, Good Hope, King Alfred* and *Leviathan*, of which the two first mentioned were lost in the war.

The ships were substantially identical "from keelson to truck." They measured 500 feet in length, with a beam of 71 feet and draft of 26 feet. The corresponding displacement was 14,100 tons. The designed power and speed were respectively 30,000 horsepower and 23 knots. While it is not certain that the mean displacement on each of the trial runs referred to later was the "normal" 14,100 tons, that is assumed to be the case.

In the powering of ships, the formula almost universally adopted is:

$$H = \frac{D^{2/3} \times V^3}{K}, \qquad (1)$$

where H is the horsepower required, D is the displacement in tons, V the speed in knots, corresponding with H, and K is a so-called "constant" whose value depends upon a variety of considerations, such as the relative fineness of the underwater form of the ship, the relation of length to the other main dimensions and to the speed, and to some extent upon the absolute size of the vessel. In the choice of a proper value for this constant, the designer requires to have before him the results of a large amount of experience, both his own and that of others, and the element of judgment enters to a very large degree. In many cases use is made of model basin experiments to check the power calculated from the formula.

The converse of equation (1) may be written:

$$K = \frac{D^{2/3} \times V^3}{H}, \qquad (2)$$

and is used in analysis, while (1) is used in design. In the present *design*, $H = 30{,}000$, $V = 23$, $D = 14{,}100$, $D^{2/3} = 581$, $V^3 = 12{,}167$, and $K = 253.3$, for the maximum power and speed.

The four ships mentioned had trials at a variety of speeds, and the results of the more important of these trials in speed and power are tabulated in Table I, arranged in order of speed. In each case the corresponding

TABLE I

Speed	Horsepower	K	Ship
9.52	1,685	298.6	*Drake*
13.06	4,014	323.6	*Drake*
15.17	6,743	301.8	*King Alfred*
15.24	6,481	318.4	*Leviathan*
15.41	6,520	327.1	*Drake*
15.43	6,937	308.7	*Drake*
15.91	7,953	295.2	*Good Hope*
17.93	9,872	345.7	*Drake*
20.03	14,801	316.5	*Drake*
21.6	21,450	273.9	*King Alfred*
21.96	22,900	269.6	*Leviathan*
21.98	22,540	274.6	*King Alfred*
22.08	23,103	271.7	*Drake*
22.1	22,467	280.2	*Good Hope*
22.16	22,534	281.6	*Drake*
23.05	30,557	233.6	*Drake*
23.05	31,088	229.6	*Good Hope*
23.25	31,592	231.9	*Leviathan*
23.465	31,156	241.7	*King Alfred*
24.11	31,409	260.1	*Drake*

value of the "constant" K, as well as the name of the ship, is given.

To eliminate as nearly as may be the results of accidental disturbances in the trials, such as meeting with unexpectedly heavy weather, etc., the results of the entire series are averaged by means of a smooth curve passed as nearly as possible through the various points representing the individual trials. In this way it becomes reasonable to give the values taken from the curve, and re-

sultant from this process, a weight which the individual readings would not have, and to base upon them computations which, if resting solely upon the performance of one ship, would be of interest only as pertaining to that one vessel. This curve is shown by the solid line in Fig. 1.

Omitting the single value above 24 knots from the trials of the *Drake*, as being discordant with the remaining results,* the values of horsepower for each knot of

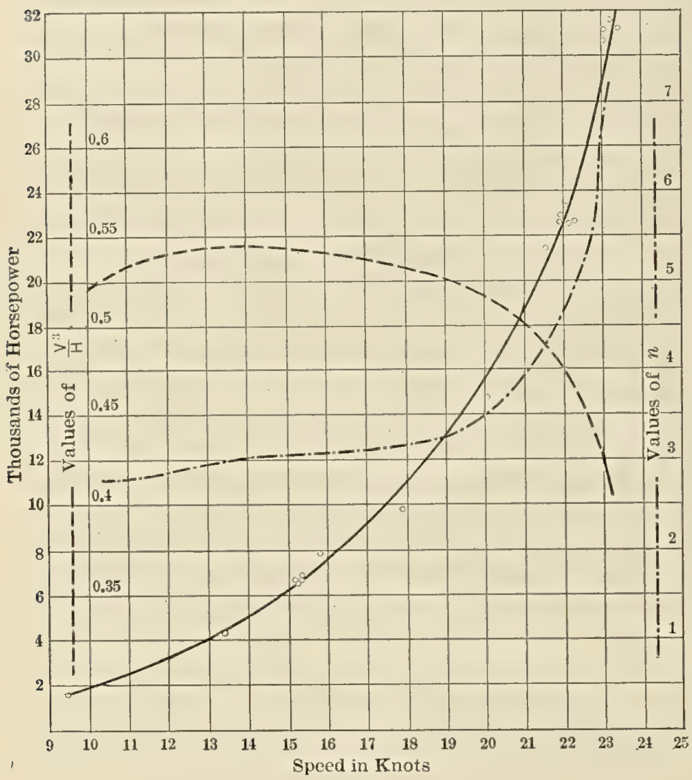


Fig. 1

speed from 10 to 21 are given in Table II, as well as for each half-knot from 21 to 22.5, and for each quarter-knot from 22.5 to 23.25 knots speed. Values of the cube of the speed are also given, as well as of K and of increments in H.

Examining the increments of power, it is at once obvious that the amounts required to increase the speed by one-quarter knot, from 23 to 23.25 knots (2,200 horsepower), is the same as that required for the half-knot from 21.5 to 22 knots; is more than that for the knot from

TABLE II

V	H	K	ΔH	V^3	Log H_2/H_1	Log V_2/V_1	n
10	1,920	302.5	.....	1,000	....	....	.....
11	2,500	309.1	580	1,331	.114 944	.041 393	2.779
12	3,200	313.4	700	1,728	.107 210	.037 796	2.835
13	4,050	315.	850	2,197	.102 434	.034 762	2.948
14	5,050	315.	1,000	2,744	.095 866	.032 188	2.98
15	6,225	314.1	1,175	3,375	.090 963	.029 962	3.033
16	7,600	313.	1,375	4,096	.086 716	.028 028	3.094
17	9,170	310.9	1,570	4,913	.081 707	.026 227	3.115
18	10,975	308.6	1,805	5,832	.078 094	.024 814	3.146
19	13,050	305.	2,075	6,859	.075 182	.023 481	3.2
20	15,500	299.4	2,450	8,000	.075 182	.022 275	3.372
21	18,500	290.8	3,000	9,261	.077 004	.021 189	3.636
21.5	20,400	282.9	1,900	9,938	.042 576	.010 216	4.165
22	22,600	273.2	2,200	10,648	.044 540	.009 986	4.461
22.5	25,200	262.4	2,600	11,391	.047 275	.009 762	4.848
22.75	26,700	255.9	1,500	11,775	.025 306	.004 799	5.28
23	28,600	247.	1,900	12,167	.029 789	.004 746	6.282
23.25	30,800	236.9	2,200	12,568	.033 021	.004 691	7.045

* This was made with a new set of propellers; eventually, all four ships, with improved propellers, exceeded 24 knots speed. It will be noted that, in addition to this one point, there are two others from the trials of the *Drake*—those at 17.93 and at 20.03 knots—which represent better results than those on the line of the curve. All of these were obtained with the improved form of propeller.

18 to 19 knots; for the two knots from 13 to 15 knots, and for the three knots from 10 to 13 knots. That there is a rapidly increasing augmentation of power required for relatively slight increases in speed is shown by the fact that the quarter-knot, from 22.5 to 22.75 knots, requires only about two-thirds the increase in power demanded by the quarter-knot from 23 to 23.25 knots.

By taking the consecutive values of H and V in Table II and comparing them by means of the formula for power,

$$H = C\,V^n, \tag{3}$$

where C is an absolute constant and n a variable index, values of this index may be readily obtained. The simplest method consists in taking respectively the logarithms of H_2/H_1 and V_2/V_1, where H_1 and H_2 represent successive values of the power and V_1 and V_2 the corresponding successive values of the speed, and dividing log H_2/H_1 by log V_2/V_1. The result will be the index required. The index thus obtained is applicable only to the particular interval over which it is computed, and has no reference to the other intervals of speed involved; but the results of such a computation show vividly the enormously augmented demands for power as the speeds become high. In Table II are given, in addition to the items previously enumerated, values of these logarithmic quantities covering in each case the speeds immediately adjacent, and also a series of values of n representing the quotient:

$$\frac{\log H_2/H_1}{\log V_2/V_1} = n. \tag{4}$$

Equation (4) is obtained from (3) as follows:

$$H_1 = C\,V_1^{n_1}, \tag{5}$$

and

$$H_2 = C\,V_2^{n_2}. \tag{6}$$

Dividing (6) by (5), we have:

$$\frac{H_2}{H_1} = \frac{V_2^{n_2}}{V_1^{n_1}}. \tag{7}$$

But n_1 and n_2 are not very dissimilar in value. If we write

$$\frac{H_2}{H_1} = \frac{V_2^{n_2}}{V_1^{n_1}} = \left(\frac{V_2}{V_1}\right)^n, \tag{8}$$

it is apparent that n will be some value greater than n_1 or n_2, for, taking all values with subscript $_2$ greater than the corresponding values with subscript $_1$,

$$\left(\frac{V_2}{V_1}\right)^{n_2} < \frac{H_2}{H_1} > \left(\frac{V_2}{V_1}\right)^{n_1}. \tag{9}$$

It may be shown, however, that the difference between n, n_1 and n_2 within the narrow limits represented between successive values of the speed is negligible, for, from equation (6),

$$n_2 = \frac{\log \dfrac{H_2}{C}}{\log V_2}. \tag{10}$$

Then

$$n - n_2 = \frac{\log H_2/H_1}{\log V_2/V_1} - \frac{\log H_2/C}{\log V_2} \tag{11}$$

$$= \frac{\log V_2 \times \log H_2/H_1 - \log V_2/V_1 \times \log H_2/C}{\log V_2 \times \log V_2/V_1}. \tag{12}$$

Dividing (12) by (10), we have:

$$\frac{n - n_2}{n_2} = \frac{\log V_2 (\log V_2 \times \log H_2/H_1 - \log V_2/V_1 \times \log V_2^{n_2})}{\log V_2 \times \log V_2/V_1 \times \log V_2^{n_2}}, \quad (13)$$

in which the term $\log V_2$ cancels from both numerator and denominator. Substituting in (13) from the first set of values in Table II, and assuming, for the present, that $n_2 = n = 2.779$, we have:

$$\frac{n - n_2}{n_2} = \frac{1.041393 \times .114944 - .041393 \times 2.779 \times 1.041393}{.041393 \times 2.779 \times 1.041393}$$

$$= \frac{.114944 - .115031}{.115031},$$

which gives a negative result. This is due to the fact that the actual value of n_2 is slightly less than that of n, or less than 2.779, and a proper correction would reduce the value of the quantity here represented by .115031 to something less than .114944, and thus produce a positive difference, which should obtain. It is quite evident, however, that $n - n_2$ is so nearly zero as to be wholly negligible. The same may be shown of $n - n_1$ and of $n_2 - n_1$. This establishes the validity of equation (4), from which the values of n given in Table II have been computed.

The "dot-and-dash" curve in Fig. 1 represents graphically the values of n as taken from Table II. It is seen that up to about 18 knots the increase in value is very gradual, and the values are in the neighborhood of 3, but at higher speeds the slope of the curve becomes very abrupt, until at the maximum speed indicated the value of the index exceeds 7.

When a wider range of operations is considered, as, for instance, the value of n between 10 and 20 knots or between 15 and 23 knots, it is obvious that the difference between n and n_2 or n_1 would be somewhat greater than when the intervals are smaller. Assuming, however, the applicability to this purpose of equation (4), Table III has

TABLE III

Range of V	Log H_2/H_1	Log V_2/V_1	n
From 10 to 15 knots	.510 838	.176 091	2.896
" 10 " 20 "	.907 031	.301 030	2.925
" 10 " 23 "	1.173 065	.361 728	3.244
" 15 " 20 "	.396 193	.124 939	3.062
" 15 " 23 "	.662 227	.185 637	3.567
" 20 " 22 "	.163 776	.041 393	3.957
" 20 " 22.5 "	.211 069	.051 153	4.127
" 20 " 22.75 "	.266 034	.060 698	4.388
" 20 " 23 "	.298 219	.065 393	4.564

been constructed, showing the variation of n over several selected ranges of speeds.

From this it is seen that, in general, the wider the range under observation, with the upper limit fixed, the lower will be the value of n, this being especially the case when the range extends down into the lower values of V. Not until the lower limit is pushed up to a high value of V does the value of n approach anything comparable with the high values in the lower half of Table II.

A final analysis, that of the values of $\frac{V^3}{H}$, representing $\frac{K}{D^{2/3}}$, has been made, and the values plotted in the dotted line in Fig. 1. These values are, of course, proportional to K, for $D^{2/3}$ is constant. The falling off of the curve at high speeds is but another indication of the extreme power cost of such speeds.

Nothing has been mentioned as to the cost of a horsepower in coal consumed at the various speeds, and, indeed, such a feature is without the scope of the present discussion. It may be noted in conclusion, however, that the forcing of the fires and engines incident to the maintenance of high speed is very detrimental to efficiency, and that a unit of power costs much more at 23 knots than it does at 15 or 20 (when the maximum speed is 23 knots). Thus the cost of coal (for the higher speeds) will vary with the speed at a still higher index than that shown for power.

Dravo Contracting Company Launches the Towboat Elsey Practically Complete

THE sternwheel towboat *Warren Elsey,* which is being built for the Vesta Coal Company, Pittsburgh, Pa., to be used in towing coal for the Jones and Laughlin Steel Company in the local rivers, was launched at the Engineering Works Department yards of the Dravo Contracting Company, Pittsburgh, Pa., on March 29.

In Ohio River side-launching experience the launching was unique, since the towboat was practically complete when she took the water. All equipment, including engines, boilers, piping, stern wheel, all auxiliaries and the upper cabin had been installed while the boat was still on the ways. The hull, boiler deck and pilot house are all steel; the crew quarters on the upper deck, however, are made of wood.

On account of the height and weight of the superstructure and machinery above deck, careful observations were made on the behavior of the boat during launching, including the determination of the maximum list, the list of the boat on recovery, the maximum depth of water taken, the angularity of the longitudinal axis of the boat to the ways when taking the water, the speed of the boat when leaving the ways, and the sagging of the boat after flotation. The accompanying cross-section illustration shows certain details during the launching period.

Launching Apparatus

Four pairs of equally spaced launching sleds were used. These were placed under the boat as built, level longitudinally and athwartship. The launching ways, which have a slope of 1¾ inches in 12 inches, are supported permanently on concrete piers, except for the outer ends, which are on piling.

Data Showing Behavior of the Boat When Launched

The height of the boat above water when leaving the launching ways was 3 feet 6 inches; the speed of the boat, 16 feet per second; the time of launching from the minute the lines were cut until the vessel took the water, 11 seconds; the maximum list of the boat, 9 degrees. The latter information was determined by the use of a glass U-tube with vertical legs spaced 3 feet apart, half filled with thin paint, and located at a fixed position on the upper deck. A pendulum indicator consisting of a 10-pound mass mounted on a stiff bar with an arm radius of 24 inches was also used. This was entirely unsatisfactory. However, better results might have been obtained had the radius arm been much shorter.

On the recovery the boat listed 5 degrees in the other direction. The boat dipped 18 inches lower on the stern when taking the water than the draft afterwards maintained at this point. The latter observation was made by two observers located on the shore with levels. The

readings were taken on the stern flag staff, which was graduated. It was observed that the boat left the ways squarely. The two observers, sighting past range poles located at the water's edge, estimated only a 6-inch variation for the length of the boat.

The stern launching sled, which carried a weight of 111 tons, had a pressure of 4 1/10 tons per square foot on the ways. After flotation, the boat showed practically no sagging or hogging. The readings taken at quarter points showed a deflection of only one-sixteenth inch.

Specifications

The weight of the boat when launched was 367 tons, figuring displacement; the draft at the stern was 4 feet 3⅜ inches, and at the bow 2 feet 8¾ inches.

The main dimensions of the boat are as follows:

Overall length	162 feet 0 inches
Hull length	137 feet 5 inches
Beam	27 feet 0 inches
Depth	6 feet 6 inches
Chamber and dead rise, each	6 inches

The boat is fitted with two engines of the tandem compound type, 14 inches diameter of high-pressure cylinder, 30 inches diameter of low-pressure cylinder, and 6-foot stroke. The stern wheel is 20 feet in diameter and 18 feet 6 inches long. Steam is supplied by three boilers, each 40 inches in diameter by 28 feet long, at a pressure of 200 pounds per square inch.

American Sea-Going Merchant Shipping on January 1, 1919

THE sea-going American merchant ships of 1,000 gross tons or over on January 1, 1919, comprised 1,663 vessels of 5,656,856 gross tons, of which 1,344 of 5,138,664 gross tons were steamers (including 60 vessels of 125,421 gross tons propelled by gas engines), and 319 of 518,192 gross tons were sailing vessels. It should be borne in mind that in addition to these ships documented as merchant vessels the War Department and Navy Department are operating as transports and for other war purposes former merchant ships, not at present documented as such, numbering 55 of 396,829 gross tons.

The growth of this fleet during the calendar year 1918 is shown by the following statement of the total tonnage of such ships at the beginning of each month of 1918 and January 1, 1919:

Month.	Steam.		Sail.		Total.	
	Number.	Gross.	Number.	Gross.	Number.	Gross.
1918.						
January	817	3,147,349	324	534,351	1,141	3,681,700
February	829	3,226,031	324	533,268	1,153	3,759,299
March	834	3,258,809	312	516,248	1,146	3,775,057
April	866	3,391,826	312	514,604	1,178	3,906,430
May	880	3,456,834	316	520,340	1,196	3,977,174
June	927	3,364,905	319	524,921	1,246	3,889,826
July	965	3,788,676	315	518,216	1,280	4,396,892
August	1,017	4,005,296	318	522,327	1,335	4,527,623
September	1,061	4,133,317	318	521,659	1,379	4,654,976
October	1,131	4,360,606	315	513,200	1,446	4,873,806
November	1,201	4,614,021	319	519,396	1,520	5,133,417
December	1,264	4,827,263	316	514,372	1,580	5,341,635
January, 1919	1,344	5,138,664	319	518,192	1,663	5,656,856

During the nine months ended March 31, 1919, the output of American shipyards was three times the figures of the corresponding period a year ago. The output of wooden steamers increased from 22,171 gross tons during the nine months ended March 31, 1918, to 674,156 gross tons during the nine months just ended.

The total number of vessels built in American yards during the nine months just ended was 1,469, and the total gross tonnage 2,564,874. In addition to this, there were built for foreigners during the nine months ended March 31, 1919, 49 wooden vessels of 101,708 gross tons.

During the corresponding period a year ago, 1,065 vessels of 823,490 gross tons were built in American shipyards. In addition to the above, there were built for foreigners during this period 9 wooden vessels of 9,489 gross tons and 13 steel vessels of 39,042 gross tons, making a total of 22 vessels of 48,531 gross tons for foreign owners.

The 1,344 sea-going steamers of 5,138,664 gross tons on January 1, 1919, are classed by gross tonnage as follows:

Size (gross tons)	Steel.		Wood.		Total.	
	Number.	Gross.	Number.	Gross.	Number.	Gross.
1,000-1,999	119	195,188	75	112,956	194	308,144
2,000-2,999	372	897,496	108	275,447	480	1,172,943
3,000-3,999	134	459,943	25	76,405	159	536,348
4,000-4,999	124	569,113	......	......	124	569,113
5,000-5,999	165	911,154	......	......	165	911,154
6,000-6,999	126	805,877	......	......	126	805,877
7,000-7,999	48	361,071	......	......	48	361,071
8,000-8,999	22	183,398	......	......	22	183,398
9,000-9,999	3	28,392	......	......	3	28,392
10,000 & over	23	262,224	......	......	23	262,224
Total	1,136	4,673,856	208	464,808	1,344	5,138,664

The fleet of 1,344 sea-going steamers of 5,138,664 gross tons on January 1, 1919, was established as follows:

Item.	Steel.		Wood.		Total.	
	Number.	Gross.	Number.	Gross.	Number.	Gross.
Amer. steamers on June 30, '14	384	1,349,631	19	26,121	403	1,375,752
Foreign - built steamers admitted to Am. registry under ship registry act of Aug. 18, 1914, and lesser acts	143	623,963	......	......	143	623,963
Seized German vessels	44	230,676	......	......	44	230,676
Built and documented year ended—						
June 30, 1915	12	62,222	......	......	12	62,222
June 30, 1916	35	172,356	2	3,063	37	175,419
June 30, 1917	61	317,236	21	30,991	82	348,227
June 30, 1918	194	861,654	45	88,704	239	950,358
Six mos. ended Dec. 31, 1918	263	1,056,118	121	315,929	384	1,372,047
Total built since June 30, 1913, and remaining on list	565	2,469,586	189	438,687	754	2,908,273
Grand Total	1,136	4,673,856	208	464,808	1,344	5,138,664

The foreign-built steamers admitted to registry and now under the American flag were all steel steamers (there being relatively few wooden sea-going foreign steamers) and were transferred to the American from the following foreign flags:

Transferred from—	Steel.		Transferred from	Steel.	
	Number.	Gross.		Number.	Gross.
British	63	264,739	Norwegian	2	8,188
German	25	130,350	French	2	6,595
Japanese	12	67,974	Chilean	1	4,725
Austrian	13	53,030	All other	9	29,807
Dutch	6	26,577			
Cuban	7	21,173	Total	143	623,963
Danish	3	10,805			

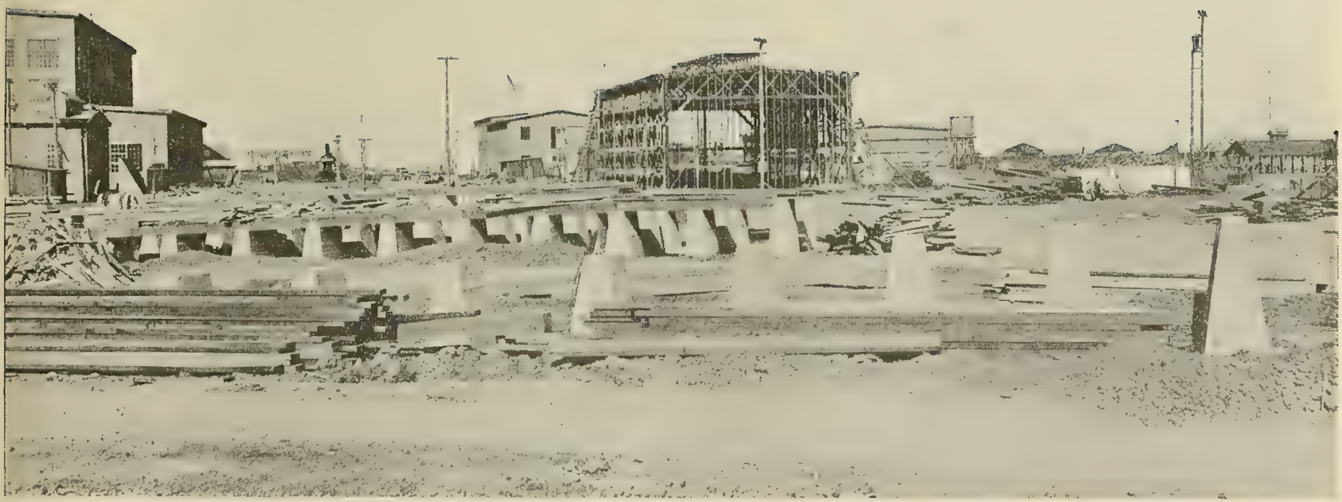


Fig. 1.—Portion of the Pacific Coast Shipbuilding Company's Yard During Process of Construction, Showing the Concrete Bases of the Ways

Steel Shipyard on Suisun Bay, California

Pacific Coast Shipbuilding Plant Provides Eight Shipways on Concrete Foundations—Water Frontage of 2,800 Feet—Excellent Shop Facilities

THE Pacific Coast Shipbuilding plant, which is situated on the shores of Suisun Bay, a branch of San Francisco Bay, is about thirty-five miles on an air line east of San Francisco. The plant, which has the distinction of having been called "the shipyard twelve miles inland," is located along the waters of the bays—freshened by the Sacramento and the San Joaquin rivers, whose confluence lies not far from the yard—a circumstance which obviates barnacles and teredos and assures the preservation of submerged timbers.

Personnel of the Company

The company was organized in 1917 by men who have long been identified with shipbuilding and financial developments along the coast. R. N. Burgess, president of the Western Mortgage & Guaranty Company of San Francisco, assumed the presidency of the shipbuilding company. John T. Scott, builder of the old battleship *Oregon* and for many years identified with the Union Iron Works in San Francisco and later with the Moore & Scott Shipbuilding Company, serves as one of the vice-presidents of the company. G. S. Radford, a graduate of the Massachusetts Institute of Technology and of Annapolis, and for some time superintendent of the Norfolk Navy Yard and other naval posts, also serves as vice-president and consulting engineer. Mr. Radford has made a study of industrial organization in civilian life when connected with large enterprises, and has also served as contract manager for the Emergency Fleet Corporation. Colonel D. C. Seagrave, who serves as vice-president and general manager of the plant, has brought to the enterprise experience as a mining engineer, after his graduation from the University of Nevada, and executive ability gained from his work in the Field Artillery Corps after graduating from West Point, re-entering the Army during the present war to serve as executive assistant to General Williams, chief of ordnance. G. L. Downing serves as secretary and treasurer of the company. In addition to these officers, the board of directors includes Henry T. Scott, a pioneer steel shipbuilder of the San Francisco region in the eighties when connected with the Union Iron Works, who also has wide financial and industrial interests.

Yard Well Located

The site of the shipyard, which is one of the largest in the country, embracing 233 acres, is located in a rapidly developing industrial region near Bay Point, Contra Costa county, under the shadow of Mount Diablo. The plant has a water frontage of 2,800 feet, with ample space for the launching of the largest vessels. Three main railroads touch the property and two electric power lines are available, as well as three oil lines which tap the large oil fields of California.

On this advantageous location the plant was constructed in record time. Less than four months after ground had been broken for the work at the yard, the first keel was laid in the presence of Charles Piez, then vice-president of the Emergency Fleet Corporation. Six months to the day after the breaking of the ground four keels were down. Within a year of the beginning of operations the working force of the yard numbered 3,500 and was still growing.

As laid out, the yard is planned for the economical handling of material, with the demands for the future expansion of the yard always kept in view.

Eight Shipways on Concrete Bases

Eight shipways were provided for in the design of the yard. Four ways are in use, upon which are being constructed the ten 9,400-ton deadweight cargo steamers as

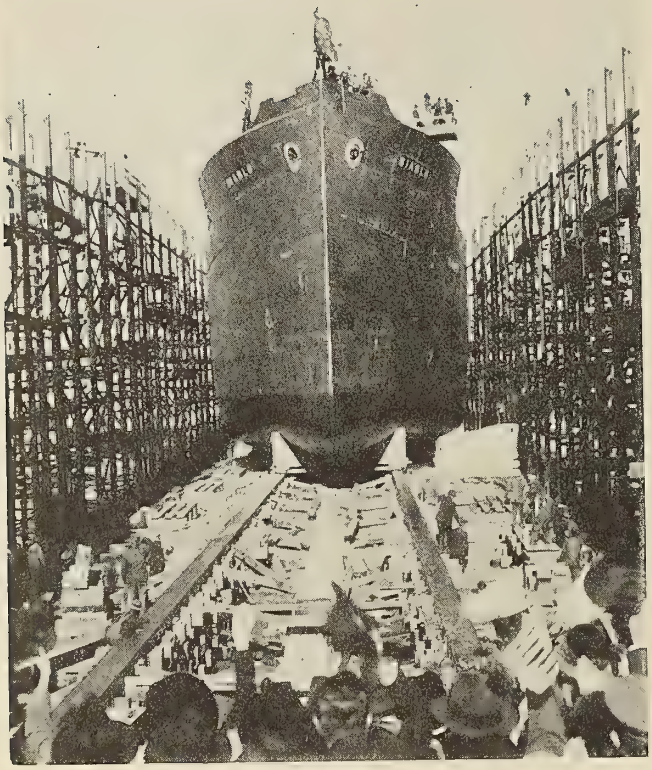


Fig. 2.—Launching of the *Diablo*

called for in the first contract received from the Shipping Board.

The foundations of the ways are of concrete. When the plant was being built there were only two other shipbuilding plants in the world in which the ways were constructed on concrete bases. This type of structure provides a capacity for building the heaviest types of ships, and will last indefinitely without repairs.

Shops and Storehouses

The most modern buildings have been constructed and the most efficient appliances installed for the handling of the materials at all stages. The plate shop, 80 by 400 feet, which is the largest building in the yard, was erected in eighteen working days. Special attention has been given to the uniform lighting both by day and by night of the mold loft, which is situated above the shop. A special building has been provided for the storage of templets.

The blacksmith shop, the machine shop—a 200-foot building—the saw mill and joiner shop, and the storehouse are all large and well fitted. The power house has been located close to the water line to facilitate the use of a short air line.

Fitting-Out Wharf

The fitting-out wharf, which is now 500 feet long, is so constructed that its length can easily be doubled as the yard expands. This is also fitted out with the most modern appliances, and is connected with standard gage railroad tracks. Over two miles of trackage have been laid in the yards, all of which connects with the main lines of the railroads.

The yard is equipped with a special fire protection system, which has been approved by the Board of Fire Underwriters and the Emergency Fleet Corporation.

Housing Provided for the Employees

The same care has been given to the welfare of the employees by planning of dwellings along the most sanitary and hygienic lines. With the assistance of the Shipping Board, a special town is being built for the employees named Clyde. This small city, which is situated three miles from the plant, will be directly connected to it by a special electric transportation railway. Much attention has been centered upon the completeness of the plans of the town, which furnishes comfortable, modern dwellings, making the most of California's residential advantages. Such minor factors as color scheme and variety of architectural design have been carefully planned by experienced artists. The housing and welfare department of the company operates a restaurant at the yard.

Work Progressing at the Yards

The first ship which took the water at the plant was named *Diablo*, after the isolated mountain peak which overlooks the plant. Since the elimination of labor disturbances on the Pacific Coast, work is progressing at a normal rate at the plant and the yard is proving the advantages of the San Francisco district as a shipbuilding center.

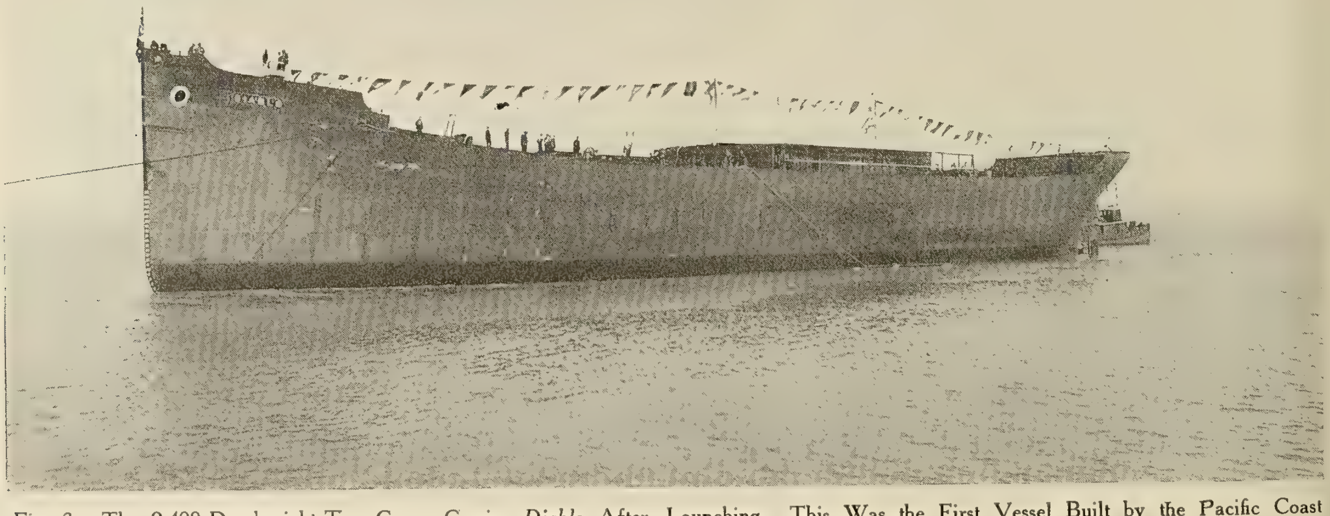


Fig. 3.—The 9,400-Deadweight-Ton Cargo Carrier *Diablo* After Launching. This Was the First Vessel Built by the Pacific Coast Shipbuilding Company

Fig. 4.—Part of the Yard of the Pacific Coast Shipbuilding Company, Showing a Portion of the Ways and Plate Racks

The Tugboat Artisan—a Product of the Yard of M. M. Davis & Son, Inc.

THE tugboat *Artisan,* built by M. M. Davis & Son, Inc., at Solomons, Md., is 133 feet long overall, 125 feet between perpendiculars, 29 feet beam and 15 feet depth. Keels and keelsons, frames, stem and center keelson, are all of oak. The sheathing is of yellow pine.

Propulsion is by a triple-expansion engine built by the Bay State Iron Works Company, Erie, Pa. The engine is rated at about 1,100 horsepower, with cylinders 18 inches, 28 inches and 45 inches diameter by 30 inches stroke. The condenser is built in as a part of the engine and has 1,721 square feet of cooling surface.

There are two boilers of the Scotch type, each having 1,500 square feet of heating surface. The boilers are designed for a working pressure of 180 pounds per square inch.

The propeller shaft is 9⅛ inches in diameter at the thrust and 10¼ inches in diameter in the tail shaft. The propeller is 11 feet 6 inches in diameter and is designed for something over 100 revolutions a minute to drive the tug at 12 knots.

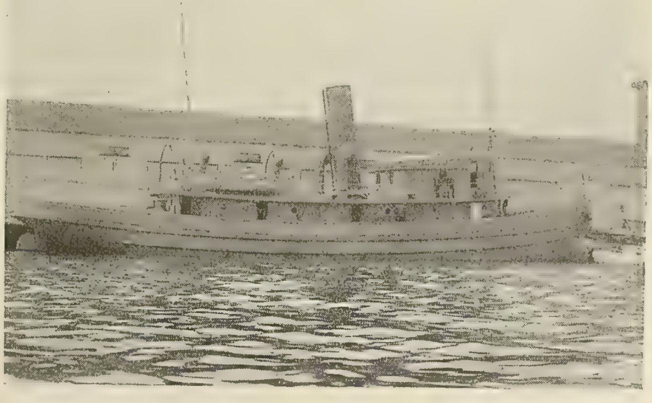
The usual auxiliary equipment consists of a circulating pump, donkey pump, feed and air pump, feed water heater, wrecking pump, electric generator, and all the other usual accessories.

Before the United States entered the war, the Davis shipyard was accustomed to turning out a few boats each year for the fishing trade and for the tugboat trade. At the time we entered the war they had orders for eight barges of about 1,600 tons capacity each and the hulls for two tugboats. One of these was the tugboat *Progress,* which the Davises were building for the Bethlehem Steel Company.

It is interesting to note in passing that the Bethlehem Steel Company, although one of the largest steel manufacturers of the country, has learned that the wooden tugboat is more durable, heavier and costs 20 percent less to build than the steel tugboat.

Combination With New York Engineers

Moses, Pope & Trainer, a New York engineering concern, decided late in 1917 that they wished to enter the shipbuilding field, and particularly the wooden shipbuilding field. They were not shipbuilders, but had specialized for many years in the design and installation of power plants and machinery. The first necessity, therefore, was to find the best wooden shipbuilder available, and the result was the combination of this firm with M. M. Davis & Son. The new combination, therefore, is responsible for the *Artisan* and for the seven other similar tugs now being completed for the United States Emergency Fleet Corporation, as well as for fourteen other vessels for the Quartermaster's Department. By this combination the Davis shipyard became builders of complete vessels, instead of builders of hulls only. The results, it is believed, speak for themselves.



Wooden Tug *Artisan*

Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Operation of a Large Diesel Engine

It will probably be some years before the design of Diesel engine rooms for motorships is sufficiently standardized so that all ships may be operated in the same way. Steamships have been so highly standardized that the average licensed steam engineer can go aboard any steamship and immediately take active charge of the duties for which he is licensed. However, the design of Diesel engine rooms is now approaching standardization.

The highest development of Diesel motorships appears to include full Diesel engines for auxiliary power and electric drive for all auxiliaries. The problem of heating the ship, heat for the evaporator and drive for the emergency compressor and emergency electricity for the wireless has not yet thoroughly been worked out.

A typical installation of the modern type consists of twin main engines operated from a working platform on the lowest level. At or near the level of this platform are two auxiliary engines driving generators, an electrically-driven auxiliary air compressor, two bilge and sanitary pumps, two fire and general service pumps and two circulating pumps for the main engine, all electrically driven. Besides these, there are lubricating oil pumps, fuel oil pumps, an ice machine and a turning motor for the main engine. On the upper deck on a level with the upper gallery will be the donkey boiler, the emergency steam-driven air compressor, the evaporator and connections for heating the ship.

In such a plant it is customary for one licensed engineer to be on watch on the working platform. On the upper platform is a junior who looks after the donkey boiler, evaporator, etc., also the valve gear and heads of the main engines. Besides these two engineers, there is an oiler for the main bearings and pins and auxiliaries. Besides this crew for running the engine there are usually three day men, who may be various modifications of the usual machinist, store-room keeper and wiper, carried on large ships.

The reason for having a "top side man" on a Diesel engine is that heads of a large Diesel engine require a great deal of attention. The "top side man" watches the temperature of the heads, the water discharge from the heads, the condition of the valves, noting particularly if any exhaust or fuel injection valves are sticking. He is also to make sure that each cylinder is getting its fuel, that the fuel pipes are not air-bound, and that the cylinders are all running alike. The latter fact is ordinarily determined by the temperature of the exhaust, since each exhaust pipe of the large engine is equipped with an ordinary plug thermometer or dial pyrometer. In extreme cases an indicator card is taken from the defective cylinder.

When making a Diesel engine ready to stand by, the first step is to start the auxiliaries. This includes the independent electrically driven circulating pump. Two are usually supplied, but one suffices, as a rule, for both engines, the other being in reserve. The lubricating oil pumps must be started and the day tank must be filled with fuel oil by means of one of the fuel oil pumps. The senior engineer then satisfies himself either by actual inspection or by communication with a trusted "top side man":

First, that the engine heads and jackets are filled with water properly circulating.

Second, that the engine is thoroughly lubricated at all points.

Third, that none of the valves is dirty or sticking.

Fourth, that the fuel oil pipes are full from the pump to the injection valve. This may be ascertained by the test cock near the injection valve. These pipes may be filled, if necessary, by using the hand handles on the injection fuel pumps.

Fifth, he assures himself that there is an ample supply of starting air at the proper pressure and of the injection air, also at the proper pressure.

Sixth, he makes sure, as in the case of a steam engine, that the engine is all clear, turning gear disconnected, all tools and tackle removed and that the engine is free to turn over.

Seventh, he assures himself that the auxiliary compressor is either running or ready to run.

Eighth, he communicates to the bridge that he desires to warm the engines up. A Diesel engine requires no "warming up" in the steam engine sense of the word; however, a careful man likes to be sure that his engine will turn over, reverse freely, and that all valves, etc., are in proper working order. A very few turns will satisfy him of all this, and it is not necessary to run the Diesel more than a few revolutions to establish these facts.

The handling gear of the Diesel engine has been pretty well standardized. It consists usually of a wheel for reversing the engine and two throttles for handling. Each throttle is for three cylinders of the usual six-cylinder engine. By pulling the two levers out, they act as air throttles admitting air to the Diesel engine and starting it exactly as a steam engine is started. The levers are then shoved in clear across the centerline, whereupon they close the air off and act as oil throttles, admitting oil to the engines. The engines may then be maneuvered by manipulating the oil throttles in much the same manner as an ordinary steam throttle valve.

It is customary to hold one lever back, thus keeping three of the cylinders turning over with air, while the other three cylinders take oil. As soon as the engine takes the oil, the second lever may be thrown over and the engine is under full operation. It is customary to throw the oil valves wide open when starting a Diesel engine, in order that it may make a quick "getaway" and run no chance of a "stall," which may happen if an operator is too easy about starting. As soon as the engine is under way the oil throttles may be brought back to any desired position. This position depends, first, upon the speed of the engine desired; second, upon the smoke in the exhaust, and, third, upon the safe load for the engine.

The speed of the engine depends, of course, upon the signal received from the bridge. The smoke in the exhaust indicates poor combustion either from feeding too much oil or not enough injection air. The smoky exhaust is detected by the "top side man," who regularly opens the test cocks on the exhaust pipes for inspection. The safe load of a Diesel engine is about two-thirds of the maximum load that it is capable of carrying.

If an engineer persists in running his engine at more than 80 or 85 pounds mean effective pressure, he is inviting many troubles. These include cracked cylinders and heads, heated bearings, sticking valves and numerous minor troubles. This is the point where American Diesel manufacturers and engineers have fallen down in the past. It is the American temperament to run a machine to destruction. Ninety-nine percent of success with a Diesel engine is to hold the mean effective pressure under 85 pounds. Outside of this there is no secret to the operation of a Diesel engine except good mechanical care. The operation of the Diesel engine is a very simple matter and it has been explained in many books and periodicals. The writer, who has operated both Diesel and semi-Diesel engines, wishes to go on record as saying that the average Diesel or semi-Diesel made to-day by responsible manufacturers will give satisfaction if its rating is not extended and if it is given the same care extended to a licensed steam engine and boiler.

The writer has inspected, or had knowledge of, possibly several hundred marine Diesel and semi-Diesel engines in actual operation. While there have been accidents which could not have been foreseen, he has never known but one case of general deviltry which could not be traced directly to one of these two causes—that is to say, either the engine was overloaded or was in the hands of incompetent men.

The following statement appeared in a San Francisco newspaper at the date this article was written:

"The auxiliary ship ——— arrived in port after an 86-day sail from Sidney. The boat was equipped with ——— semi-Diesel engines, but the bo's'n, who had an engineer's (?) certificate, could not start the engines, so the good ship *sailed* all the way home."

Marine Engineer.

A Plea for the Apprentice

The training and technical education of the average engine fitter and boiler maker sadly require attention from employers. A boy eager to become an engineer enters a marine engineering shop—probably he is bound for five years' apprenticeship, which means that his employers are to teach him the trade of fitting, while he must serve them during the named period. His first interview is with the timekeeper, who initiates him into the hours of work and the penalties of any lapse of discipline. He is passed on to the foreman of generally the nearest shop, who promptly looks around for a machine man requiring a mate. The writer well remembers being taken over to a machine for turning the taper in the bossing of a propeller and the foreman's instructions to keep a note book and sketch.

So far, so good; but is this good enough? What impression does the young engineer get of his future work? Generally it is a poor one and he feels anything but happy. *En passant* I will be forever grateful to my first machine man, who gave me the soundest advice I have ever received. He told me never to funk a job. If you can't see even the first step—well, take your coat off or get out a file. Do something and the rest will come, and I have found this true.

My article is not a complaint, but a plea for a more careful consideration of the training of the apprentice in marine and boiler shops. If the boy, who by now probably is bored to death with the machine and gets into trouble because he will wander around other machines, asks for a move, he may get it or he may have to desert and risk a row; but, as a rule, he has to move on his own initiative. He then gains some experience as a fitters' mate, either in the form of an older apprentice or a journeyman. This is good if his mate is good, but he is not always good.

After two years of this casual training a boy in the lathe shop wants a move, and a chance opens for a boy in the fitting shops. A lucky one gets it and leaves several unlucky comrades behind, and so the tale of chance goes on. Granted it is that a boy with a good purpose can get around and learn, but it is generally no fault of the employer if he does so.

The writer knows within his personal experience of an apprentice who desired to learn lathe work, and, failing to be moved, he disappeared out of the fitting shop and was found in the lathe shop, from which he refused to move; so the foreman of the fitting shop went to the foreman of the lathe shop and damned the boy's character. Such was the result of ambition.

Generally three or more apprentices are required in the boiler shop to fit mountings and repair the machinery of the shop, but there is no roster kept enabling all the apprentices to learn this necessary work, and the writer had to follow the step of the boy who wanted to go to the lathe shop before he could gain this experience, and this method, although serving its purpose, is not good for the discipline of the shop or the apprentices.

The construction of boilers is a very essential knowledge to the engineer, yet how few of the apprentices are given the opportunity of actually working on boilers, fitting the mountings or actually running the boiler on the test. The marking-off table requires only one apprentice to act as mate; but is there any need that once an apprentice has learned the job he should be kept there because the journeyman is too lazy to teach another boy? For an apprentice to become efficient at any job, such as fitting boiler mountings, marking-off, turning or erecting, generally signs his death warrant so far as having opportunities of learning other sides of engineering. Apprentices come and go, and it seems as if every one is happy so long as there are plenty of mates to work with the journeymen.

Comparisons are odious, but why is it that apprentices in locomotive shops are guided through the different grades and not so apprentices in marine and boiler shops? Again, let us consider the technical training of our young engineers. Is it not quite recently that an apprentice is allowed to lie in on the morning after night classes? But not yet is it a universal practice to encourage practically the attaining of technical distinction. To allow a few hours' extra in bed after night classes and not to insist on results of the classes is only, in a majority of cases, breeding laziness. The writer has had some experience of night class lectures, and the classes are generally made up of two kinds of boys—those willing to learn, and the others who attend in order to have this class card initialed and so earn a few hours' sleep next day. Beyond this privilege mentioned, there is nothing to encourage night study except ambition, which, in most cases, is dormant until a boy reaches, say, eighteen years or even more.

There are too many poor and medium fitters and an insufficient number of well-trained engineers; and the blame lies mostly with the head of boiler making and

engineering establishments. It is as easy for a good working scheme to be thought out and put into practice as to "carry on" in the present slipshod fashion. It will benefit the employer in the long run, for, instead of having a crowd of so-called fitters hanging around his door waiting to be taken on, he can have a group of regularly employed engineers and boiler makers inside the shop.

It is my experience, and I ask the employer to believe me as a late apprentice, that these casual fitters run up the cost of a job about thirty percent. Is there any doubt that a good, well-trained fitter or boiler maker is worth two semi-trained men? I do not think so. Again, does not *esprit de corps* play another part in a good workman's life? Is it not worth money to the employer—yet, who can expect such a spirit from the man who knows he downs tools when the job is done?

Combine these two, a well-trained fitter or boiler maker and a man with a keen sense of *esprit de corps*, and surely he can compare with at least two casual fitters.

In France, during the last four years, millions of men have faced death for one word and what it means—"honor." Cannot this word be introduced into the engineering shop, or is it for the battlefield only? A boy wandering and drifting through a boiler or fitting shop never hears or sees the word, and, consequently, what are the works to him? He knows that as soon as his apprenticeship is finished his firm will perhaps offer him a pound a week, but they do not mind whether he stays or goes. They themselves place a value on their own training of an apprentice, and it amounts to nothing.

If I am asking too much for a drastic change in the system of apprenticeship, there are several smaller alterations that would mean big improvements. Why cannot there be practical tests each year with suitable encouragement to the apprentice and such places as the drawing office and marking-off table or boiler fitting shop open to the best apprentices? The boy who can use a lathe well is just the one to teach how a boiler is made and how a safety valve is made and mounted, and the boy will then be an all-round fitter.

The drawing office should be the reward of four years' hard studying—not a mere chance, as it generally is. When the writer served his apprenticeship he never saw one boiler maker apprenticeship in the drawing office, and yet his firm made marine boilers. In several big firms the sons of well-to-do men can, for a certain sum of money, ensure a good training in the different shops, but it is very rare that a poorer man's sons can do so. They must be content to stay in one shop. It does not make any difference how clever they may be.

The want of all-round trained artisans has been revealed in this war. There have been plenty of men who could do special fitting jobs, such work as they had been used to for years; but if a particular lathe man became ill the lathe was out of use until another lathe man was sent up. Yet these so-called fitters had served an apprenticeship in shops where lathes were used.

So much for the practical side of an apprentice's training; but what about the commercial side? Does he ever see inside a cost office or the estimating department except to take an occasional message? How many apprentices can tell you what the working expense of the firm is or how the file that he uses is bought and paid for? I often wonder if he ever realizes that a file or chisel costs money. It is doubtful, and yet if he knew that the more jobs a file is used on the cheaper will be the different jobs, and, consequently, the more ultimate business for the firm, surely his knowledge will be a gain to the firm.

This article has dealt mostly with the result to the firm, but it is the same with the apprentice—commercial knowledge is essential to-day. I notice constantly articles in technical papers on how to make an engineering firm pay. Surely this subject should be a part of the apprentice's education. It is quite as important for a man to know how an order is taken, sized up and estimated as how to carry it out. The other day an American engineer was brought over to England to manage one of our railways, and a certain English lord bemoaned the fact that this should be necessary and he wondered why. Let him go to any engineering firm, select any of the apprentices who have worked their way into the drawing office and ask them to tell him how the counting house or cost office is run. He will be surprised at their ignorance, yet these are important parts of a modern engineering firm, and the general manager has to know before he can attain this position.

Not many apprentices realize the weakness of their training until they become journeymen and they have ambitions towards higher jobs. Then they have to look around for books to teach them what they should have learned years ago, and, as a consequence, their time is taken up in acquiring general knowledge instead of specializing.

Now is the time for changes. Let this subject be on the list of consideration. Ten minutes' thought will be sufficient to reveal its necessity, and very little time is required to put into action a working scheme. Some firms, very few, have done so more or less; yet even they have not done all they can. Surely a big firm can afford an apprentice master whose time and energy are to be spent in controlling the teaching and training of the apprentice. Such a man should be one capable of lecturing at the night classes so that he is in touch with the apprentices during the evening as well as the day. His work in the shops need not clash with the foreman, for he is simply there to see that each apprentice goes through the different departments and that any ability developed is used accordingly. The good can be separated from the bad much better by this master than any one foreman, and the apprentices themselves will realize the importance attached to their training.

The technical committees of different towns do their best to train the apprentice theoretically, but there is at present no means of keeping a direct connection between the committee and the firms employing the boys during the day. The possibilities of good to be done by employing a qualified apprentice master are enormous, and the money invested would yield a high interest in years to come, and I should like to read of other opinions on the matter.

M. T.

NEW BOOK

Steam Engine Troubles. By H. Hamkens. Size, 5 inches by 7⅜ inches. Pages, 284. Illustrations, 276. New York, 1919. The Norman W. Henley Publishing Company. Price, $2.50.

For the practical operating engineer who has charge of stationary engines, it is of great advantage to have a comprehensive knowledge of engine troubles in general, so that costly and dangerous accidents can be avoided. In this book the troubles which the principal parts of steam engines are subject to are described, good design is contrasted with bad, the most suitable material for certain parts and the most approved construction of the same are pointed out, together with the advantages and disadvantages of many designs. No reference is made to the peculiar conditions encountered in handling marine engines.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

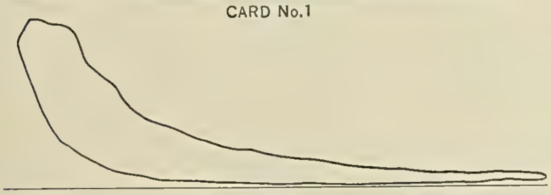
This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Indicated Horsepower of Diesel Engine

Q. (1003).—Please work out the indicated horsepower of an eight-cylinder, four-cycle Diesel engine, using the mean effective pressure as obtained from card No. 1, and also card No. 2. Diameter of cylinder, 13½ inches; stroke, 15 inches, and 380 revolutions per minute in both cases.

A. (1003).—From the tabulated calculations you will note that card No. 2 gives a higher value for the indicated horsepower than card No. 1. The wavy line of diagram

CARD No.1



CARD No. 2

No. 1 was most likely caused by the indicator piston sticking. The table below gives the result reached:

Indicator Card	No. 1	No. 2
Net area of card, square inches	.379	.455
Length of card, inches	2.53	2.64
Spring, pounds per square inch	600	600
Mean effective pressure, pounds per square inch	89.9	103.5
Length of stroke, feet	1.25	1.25
Piston area, square inches	143.1	143.1
Revolutions per minute	380	380
Indicated horsepower, per cylinder	92.6	106.7
Total indicated horsepower	741.8	854.6

$$\text{Indicated horsepower of one cylinder} = \frac{\text{M. E. P.} \times 1.25 \times 143.1 \times \frac{380}{2}}{33{,}000}.$$

Propeller Efficiency of Motorship

Q. (1005).—Data on the apparent slip of propellers are generally quoted as follows: Slow cargo boats with full lines, 0 to 8 percent; passenger boats with fine lines, 8 to 15 percent. These figures have been based and have been experienced on ships equipped with slow-speed engines, being even on large ships always under 100 revolutions per minute; but these figures do not hold good on motorboats whose engines are running at a much higher speed. In my particular case I have to deal with a twin-screw cargo boat of 8¾ knots' speed, to be equipped with two 550 brake horsepower engines, which are turning 270 revolutions per minute. The question is: What will be (1) the slip at this speed, and (2) how much would it be if under the same conditions a reduction gear were installed and the propeller shaft then turned over at 90 revolutions per minute? I am interested to know this slip beforehand, in order to figure on the basis of these data the propeller efficiency of these two different cases.

A. (1005).—The slip of a propeller depends upon the type of vessel, the propeller and its location. Hence it is very hard to give any definite answer to your question, except to say that for most vessels an apparent slip of more than 25 percent shows a fall of efficiency. In a case, cited by Admiral Dyson, of a naval fuel barge, the least effective propeller had a slip of 50 percent, and the most effective about 26 percent, the pitch ratio in the latter case being about 0.57. For your direct drive at 270 revolutions per minute you must expect to use a propeller with low pitch ratio, which will be inefficient but more efficient than one of high pitch ratio. Some of the data for low-powered auxiliaries show that a high-speed motor has been used with a pitch ratio of about 0.8; this will mean a propeller of poor efficiency when loaded under power alone, but may have been chosen with the idea of using motor and sails together. Most of the large steel motorships built in Europe have an engine speed of 130 revolutions per minute or under. Although formerly propellers were designed with reference to the apparent slip, Taylor's method does not require that the slip be assumed, but the wake factor must be chosen instead. This factor depends on a number of conditions. From Luke's "Experiments on Wake" we learn that for outboard turning twin screws a decrease in diameter will decrease the wake.

The reduction gear installation will show a far higher overall efficiency than the direct drive. This may be demonstrated by using data from Admiral Taylor's experiments.

Taking the revolutions per minute equal to 240, assume wake factor = 0.15, and efficiency of reduction gear = 0.98. Then from Fig. 213 of "Speed and Power of Ships":

R. P. M.	240	80
V.	8.75	8.75
V_a	7.44	7.44
B. H. P.	550	550
P.	37.3	12.4
Propeller efficiency	52.5*	64.8
Efficiency of propeller and gear.	52.5	63.5

$$P = \text{R.P.M.}\sqrt{\frac{\text{B.H.P.}}{V_a^5}}$$

* The efficiency curve is extended.

Although these figures should be carried out more carefully for the actual case, it is believed that they represent fairly well the relative efficiency of the two installlations. (The pitch and diameter for both cases may be obtained by carrying the solution further.)

The following references are interesting: *City of Portland*, page 292, 1916, MARINE ENGINEERING; *Cethana Motorship*, September, 1918; *James Timpson Motorship*, March, 1919.

If the reduction gearing will stand up under the fluctuation in turning moments, I believe that it offers the best solution of an efficient propeller and engine.

Fastening Zinc Plates in Boilers

Q. (1004).—I would like to know as soon as possible what the conditions are in regard to the bolts that hold up the zinc plates in marine boilers. Is it necessary to paint these bolts to keep them from rusting or is there anything on the market that can keep them in a polished state for metallic connection to zinc plates?

A. (1004).—The zinc plate neutralizes the free acids in the water by combining with them, thereby preventing the iron from corroding. Since we thus have an electro-chemical process, it is of the utmost importance to get a perfect electrical contact. If the zinc is held by pieces of flat bar, or by a basket, the important thing is to make certain that the connection between plate and boiler is through clear metal, i. e., oxide left by the blacksmith on bar iron in way of bolt is filed off. If desired, a cement wash may be put on the bolt which clamps the zinc plates to the hanger after assembling.

Shipbuilding and General Marine News

**Contracts for New Ships—Shipyard Improvements—
Engineering Projects—Improved Appliances—Personal Items**

PROPOSED VESSELS TO BE BUILT BY THE EMERGENCY FLEET CORPORATION

Increased Capacity, Greater Speed, Efficient Loading Facilities in the New Designs

It has been learned from the office of the Emergency Fleet Corporation, in connection with the recent bid of the Submarine Boat Corporation to build vessels of 12,000 deadweight tons capacity at $149 per ton, that this bid was in no sense a formal one, in so far as the corporation submitted neither specifications nor drawings.

Two Types of Large Cargo Vessels Under Consideration

Two new types of vessels, however, are now under consideration which may be substituted for vessels of smaller tonnage and slower speed, on which work is now suspended. Bids have already been asked on a 12,500-ton vessel with a sea speed of thirteen knots. Specifications of the two types are as follows:

	"A"	"B"
Length B. P., feet	470	470
Breadth, feet	63	63
Depth, feet	43	43
Deadweight, tons	12,500	14,200
Indicated horsepower	5,600	4,000
Speed (sea), knots	13	11½

The vessels will be of the shelter deck type with three decks. The machinery will be of a reliable and economical type consisting of a quadruple expansion engine and Scotch boilers, and arranged for burning oil fuel. The capacity of the oil bunkers is such as to give the vessels a radius of about 13,000 miles.

Particular attention has been paid to the economical handling of cargo, and to obtain this end two large hatches have been arranged at each hold. These will be served by double the usual capacity of winches and booms.

The accommodations for the officers and crew have been carefully studied and provide for the latest ideas as to comfort and safety. The vessels will also comply with the highest requirements of the American Bureau of Shipping and Steamboat Inspection Service.

Two types, "A" and "B," as given above, have been suggested, the principal difference being in the speed and consequent modification in deadweight capacity. On certain trade routes the higher speed of 13 knots may be desirable, and on others, depending somewhat on the length of voyage and other factors, the slower speed of 11½ knots may prove more economical.

The details of the proposition, as outlined by the Submarine Boat Corporation, are as follows:

"We are willing to undertake to build for the United States Shipping Board 12,000-ton, deadweight capacity, new American type, steel cargo ships at the Government-owned plant, Newark Bay Shipyard. . . . .

"The proposed ships will be 12,000 tons deadweight capacity steel cargo carriers, shelter-deck type, classed Lloyd's or American Bureau of Shipping 100-A1, of the transverse system of construction; length of ship between perpendiculars (Lloyd's) 473 feet, molded beam 62 feet, draft 28 feet 6 inches, single screw equipped with 5,000 indicated horsepower reciprocating steam engines, or 4,200 shaft-horsepower geared turbines, Scotch boilers, oil burning, with which power a loaded sea speed of 12 knots will be guaranteed.

"The ships would be built from the designs of our naval architect, Theodore E. Ferris, in association with our consulting naval architect, Frank E. Kirby."

NEW SOUTHERN YARD RECEIVES CONTRACTS FOR NINE CONCRETE STEAMERS

Newport Shipbuilding Corporation, Ltd., Begins Laying Down Work

The Newport Shipbuilding Corporation, Ltd., has built and equipped an extensive yard for the construction of reinforced concrete river steamers at Newbern, N. C. The officers of the company are as follows: F. E. Engstrum, president; F. O. Engstrum, vice-president; T. A. Uzzell, treasurer; R. H. Arnold, general manager, and F. R. Miles, superintendent.

This company has received a contract from the War Department of the United States Government for the construction of nine reinforced concrete river steamers designed for transporting men to various points on rivers and harbors. At present the company is engaged in laying down the work for these vessels. Whittelsey & Whittelsey, 17 Battery Place, New York, are the naval architects for the company.

Page Resigns from Shipping Board

Charles R. Page, the San Francisco member of the United States Shipping Board, has forwarded his resignation to the President.

SKINNER & EDDY RECEIVE REINSTATEMENT ON CONTRACTS AGGREGATING 250,000 TONS

Will Construct Twenty-five Vessels

Contracts for twenty-five steel vessels, to be constructed by the Skinner & Eddy Corporation, Seattle, Wash., for the Emergency Fleet Corporation, which were recently suspended, are to be reinstated according to information from Washington received on April 12. The agreement with the corporation, it was stated, involved certain reductions below the original price. About 250,000 tons are involved.

Orders have been received by the G. M. Standifer Construction Corporation, Portland, Ore., to fit the four Ballin hulls remaining on the ways with machinery. The Supple-Ballin Shipbuilding Company, Portland, Ore., had previously received orders to fit up four vessels of the same type with machinery.

Norwegian-American Line Lets Contract for Two Freighters

The Norwegian-American Line, 8 Bridge street, New York, has recently let contracts for two modern freighters of 9,500 tons deadweight to Napier & Miller, Glasgow, Scotland.

Pacific Steamship Company Will Build Coastal Vessels

A. F. Hines, vice-president and general manager of the Pacific Steamship Company, San Francisco, Cal., has announced that plans are being drawn for the building of two fast oil-burning steamers for coastwise trade. The new vessels, which will carry both passengers and freight, will be 500 feet long, with a speed of 21 knots. It is proposed that the vessels be built on the Pacific Coast, although the lowest bids will be accepted.

A new line known as the White Flyer will operate vessels in competition with the Pacific Steamship Company. The new company has been formed by Adolph Ottinger and Walter Scammell.

Dollar Steamship Company Will Build 10,000-Ton Vessels

Robert Dollar, president of the Dollar Steamship Company, in discussing the new freight service between New York and Vancouver which the company is planning to establish, has announced that special steel ships of 10,000 tons will be built for this service.

DAUGHERTY TYPE WOODEN VESSELS SOLD AT $650,000 EACH

Nacirema Steamship Company Purchases Fifteen Vessels—Will Buy Fifteen More for Future Trade Development

The consummation of the sale by the Shipping Board of fifteen 4,000-ton wooden steamships to the Nacirema Steamship Company, New York, as reported in the press of April 23, at a price of $650,000 each, is an indication of the prices which may be expected in the sale of well-built wooden tonnage. The fifteen vessels purchased will be operated by the Brooks Steamship Company, New York, five operating out of New York, five out of New Orleans and five out of Havana. The Nacirema Steamship Company, it is reported, is planning to purchase fifteen more vessels at a later date.

Ten of the vessels were built by the National Shipbuilding Company, Orange, Tex., and five by the Supple-Ballin yards, Portland, Ore. The former are of the Daugherty type, and the others of the type built at the Ballin plant.

Underwriters report that not a dollar of loss has been incurred in the operation of thirty ships of these types by the Matson Navigation Company, San Francisco, Cal., which, they point out, indicates the efficiency of these types of wooden vessels for trans-ocean service.

The Shipping Board, coincident with the announcement of this sale, has solicited bids for twenty-five wooden vessels to be opened on May 5.

PRESENT NAVY PROGRAM

Four Hundred and Thirty-eight Vessels Yet to Be Delivered

According to Washington reports, ships of all classes now building for the United States Navy number 438, including 10 superdreadnoughts, 6 battle cruisers (suspension orders on which were recently issued, as noted in the NEWS SUPPLEMENT of March 14), 10 scout cruisers, 195 destroyers, 71 submarines, 53 Eagle boats, 20 mine sweepers and 71 auxiliaries. Under the latter are included 12 oil tankers, 3 fuel ships, 2 ammunition ships, 1 hospital ship, 19 seagoing tugs and 34 harbor tugs.

Several of the superdreadnoughts have already been laid down. The *Tennessee,* building at the New York navy yard, will be launched some time in May; the *California,* at Mare Island, Cal., and the *Maryland,* at Newport News, Va., are well toward completion; the *Colorado* and the *Washington* have been laid down at the New York Shipbuilding Corporation's plant at Camden, N. J. Two more superdreadnoughts are to be built at the New York navy yard, one at the Mare Island navy yard, and another at the Norfolk navy yard.

Shipping Board Asks Bids on 431 Wooden Hulls

Bids for the purchase of 431 wooden steamship hulls and 31 wooden barge hulls were asked by the Shipping Board on Friday, April 26, as a part of its programme for disposing of surplus bottoms constructed during the war emergency. The vessels, it is reported, may be converted into sailing vessels or barges equipped with internal combustion engines if desired. Ship fittings—engines, boilers, winches, cables, etc.—can be supplied by the Emergency Fleet Corporation to complete the ships if necessary. In most cases these materials are already in the yards. Bids will be received until May 26 accompanied by cheque for 10 percent of the amount of the bid.

The United States Shipbuilding Record for One Year Totals 3,225,000 Gross Tons

From April 1, 1918, to April 1, 1919, a total of 2,056 merchant vessels of 3,225,521 gross tons were built in the United States, and officially numbered by the Bureau of Navigation, Department of Commerce. Of these, steel seagoing vessels amounted to 2,178,939 gross tons.

SHIPPING BOARD REFUSES BIDS ON FOUR VESSELS

Offers for Reconstructed Lake Carriers Less Than Half Appraisal

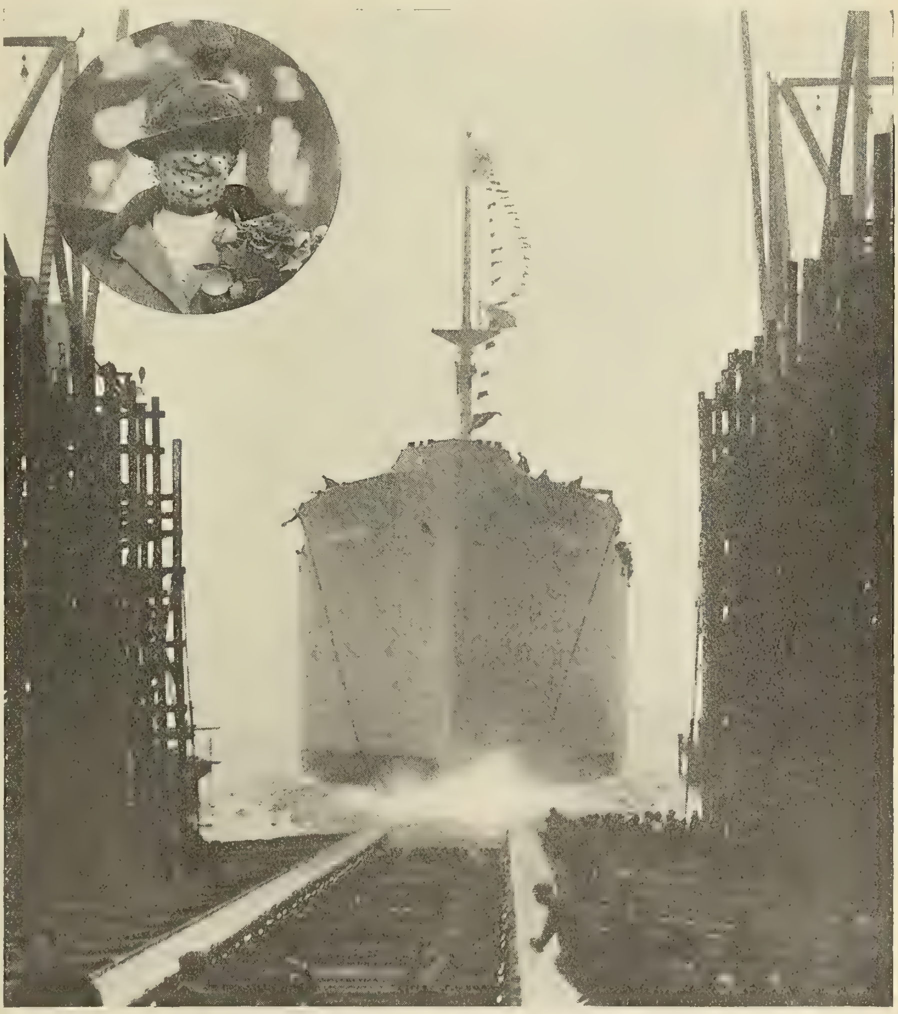
All bids received by the United States Shipping Board for four steel reconstructed lake steamers were refused on April 22, and the vessels were again advertised for sale, bids to be opened on May 5.

"The prices were about 40 percent of the appraised value of the vessels as determined by the Ocean Advisory Commission by a fair and impartial appraisement," is the statement issued by the Shipping Board.

Edward P. Farley & Company bid $142,000 each for the four vessels, the *Adrian Iselin,* 3,075 tons deadweight; the *Lucius W. Robinson,* 2,825 tons; the *F. P. Jones,* 2,850 tons, and the *A. D. Mac-Tire,* 2,925 tons.

N. A. Iselin & Company bid $158,000 for the *Iselin,* $126,000 for the *Robinson,* and $133,000 each for the *Jones* and the *Mac-Tire.*

The New England Fuel & Transportation Company bid $1$1,0co for the *Robinson.*

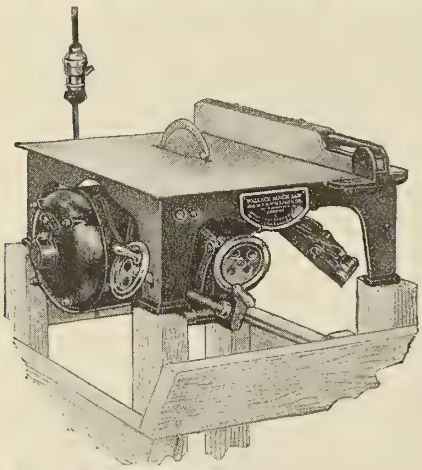


(Photo by International Film Service)

The *East Side* Launched by the Standard Shipbuilding Corporation, Shooter's Island, N. Y., on April 5

New Wallace Bench Machine

The Wallace bench saw, which is being put on the market by J. D. Wallace & Company, 1407 West Jackson Boulevard, Chicago, Ill., is a portable bench tool designed to be operated by ordinary electric light current. It has ample power to take a full 2-inch cut through the hardest wood, making it possible to use this machine for at least 80 percent of the work generally done by hand or on the big circular saw in the pattern shop. For angle cutting the saw itself is tilted, consequently the operator is always working on a table which is in a horizontal position. By a handwheel mounted on a perfectly cut screw, acting in a swiveled nut, the saw may be set at an exact angle. This mechanism swings the cradle in which the motor-driving mechanism and saw are mounted.



Portable Bench Tool Operated by Electric Current

The Wallace saw is provided with a shutter saw guard built into the machine to protect the operator's hands, and to prevent the catching of the end of the stock in the back of the saw or the catching of the waste stock in the teeth of the saw.

Smooth-On for Repair Work

Smooth-On, which is manufactured by the Smooth-On Manufacturing Company, Jersey City, N. J., may be put to many uses in and around the shop for quick repair work. The mixture, when brought to the consistency of putty, can be utilized to fasten metal to a brick or concrete wall, or to tighten loose handles on tools. Mechanics have found it of use in permanently fastening washers or lock nuts to bolts, imbedding sockets in cement and fixing lock nuts in similar material. Smooth-On Number 1 is the preparation used for such jobs.

Dreadnaught Rubber Safety Suit

A new safety suit called the Dreadnaught, which has recently been put on the market to replace the ordinary life preserver, is the product of the Safety-At-Sea Corporation, 1358 Broadway, New York city. The apparatus consists of a one-piece garment of rubberized material which, the company claims, is absolutely watertight unless cut or damaged. The elastic rubber collars and wristlets, which may be noted in the illustration, are adjustable to any size of neck or wrist. The soles are of pliable gravity leather. The buoyancy of the garment is furnished by a silky fiber jacket made of Kapok, which fits inside the rubberized coat. Either coat or jacket may be worn separately.

Dreadnaught Rubber Suit

The complete apparatus, which can be adjusted in less than a minute, is furnished in a special canvas carrying wrapper which measures approximately 18 inches by 12 inches by 7 inches and weighs only 14 pounds. The suit may be worn in case of shipwreck or as a protection to seamen engaged in work about the ship in rough weather.

Shipping Board Converts One Hundred Ships Into Oil Burners

Report has been received that the Shipping Board is planning to convert 100 vessels, built on the Great Lakes and equipped to use coal as a fuel, into oil-burning vessels. Major Cushman, Assistant Director of Operations, has verified the report, but is unable to give details because the arrangements have been handled direct from Washington.

Within two weeks of the opening of navigation a fleet of ninety-eight ships will be brought down the St. Lawrence River from the Great Lakes. At least 300 ships will be completed here during the summer. Of this number 150 will be oil burners. The average tonnage of the ships is 3,500 tons. The fleet will also include fifty seagoing tugs, all of which have been built on the Great Lakes.

The Beaver Jr. Number 3

The accompanying illustration shows a pipe-threading tool known as the Beaver Jr. Number 3, which is supplied by the Borden Company, Warren, Ohio. It consists of one ratchet handle and individual die heads in sizes ranging from 1/8 to 1 inch. The tool can be used to advantage close to walls or rafters, in corners, against ceilings or in other difficult positions. Separate heads can be furnished to cut left-hand threads. The ratchet is controlled by a spring thumb-bolt of large size with a good grip, so that it can be turned with greasy hands without trouble. The Number 3 Beaver Jr. is made in American Briggs Standard and Whitworth Pipe Standard.

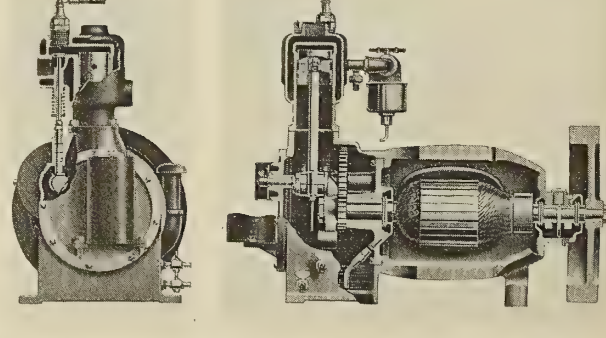
Beaver, Jr., Number 3

Compact Lighting Plant for Marine Installation

The Matthews Engineering Company, Sandusky, Ohio, has added a new unit, "Little Husky," to its line of full automatic lighting plants. This plant, which carries a 300-watt continuous rating on the generator, is made in the 32-volt type.

The generator frame and engine crank case are cast integral. The engine is a 4-cycle cooled type of 2-inch bore and 3-inch stroke. A 60-ampere hour Willard glass cell storage battery is used with the plant.

The adaptability of this plant to marine installations may be judged from the following measurements, which show the compact design. When mounted on skids, lengths of which are 44¾ inches, the height of the apparatus from the bottom of the skid to the top of the vacuum feed is 29 inches; width (diameter of tank), 16 inches. When furnished unmounted and without gasoline (petrol)



Cross-Sectional Views of Compact Marine Lighting Plant

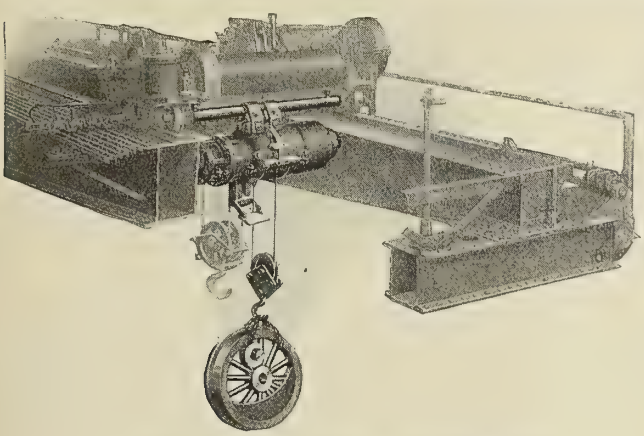
tank, as is the general practice for marine installations, the length, from the end of the shaft at the flywheel to the edge of the coil, is $22\frac{1}{8}$ inches, and from the base of the plant to the spark plug $18\frac{1}{8}$ inches. The width of the plant (diameter of flywheel) is 10 inches.

The plant is also furnished with circulating pump for marine installations. As may be noted from the illustrations, the coil is mounted on the end plate of the crank case, the breaker on the end of the cam shaft. The armature is the standard laminated drum type, handwound, with closed slots for retaining the windings.

Payne Auxiliary Hoist for Traveling Cranes

N. B. Payne & Company, 25 Church street, New York, is placing on the market a practical auxiliary hoist which may be attached to any standard overhead electric crane. The details of the apparatus are clearly shown in the accompanying illustration.

The manufacturers point out that the hoist does not take any more overhead room, does not require an extra trolley, does not shorten the travel of the trolley on the bridge, nor interfere with the accessibility of the main hoist. The average crane in a day's work handles a greater number of light loads than heavy. Since cranes for lifting heavy loads are slow-moving, their use results in a serious loss of time. These auxiliary hoists handle a light load of, say, three tons at a speed two to ten times as fast as the larger crane could possibly attain. The saving in power and the elimination of unnecessary labor are contributing factors.



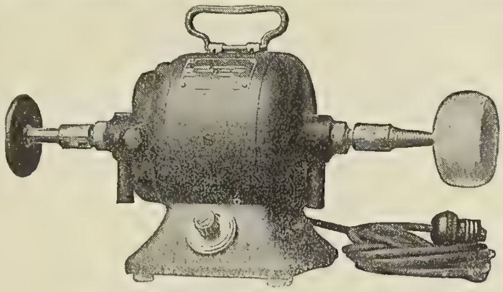
Payne Auxiliary Hoist for Traveling Cranes

By the application of this auxiliary attachment, any standard single-hoist electric traveling crane may be equipped with two lines for drop-bucket service. The auxiliary can be attached by the purchaser.

These standard auxiliary hoists are supplied in from 1- to 5-ton sizes. Larger special sizes, however, may be furnished for particular work. The control may be arranged from cage, floor or pulpit to suit the crane to which the apparatus is to be applied.

Motors for Polishing and Grinding

By the use of the polishing and grinding motors supplied by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., these operations are easily accomplished by simply snapping the switch to start the motor and applying the attachment to the surface for a few moments. The motor is always ready, and can be connected to any ordinary socket for use when grinding small parts.

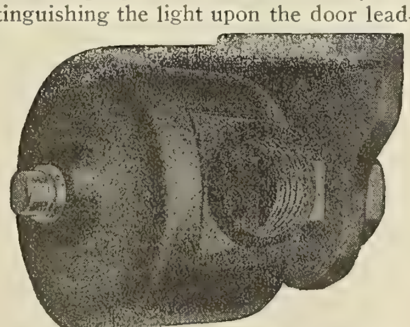


Motor for Polishing and Grinding

Marine Water-Tight Door Switches

On all vessels traversing the sea in war time it was found essential that the interiors be lighted adequately. It was also essential that the decks and exterior of the ship be submerged entirely in darkness, except as for such enclosed lights as are necessary for running.

To open the door from a passageway upon the deck, without at the same time putting out the light, would have risked transmitting a signal to a waiting submarine. The door switches which are illustrated here were designed, therefore, for the purpose of instantaneously extinguishing the light upon the door leading to the deck being opened, even slightly.



Watertight Door Switch for Direct Action

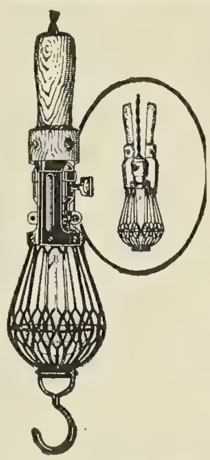
The devices are watertight, made rugged throughout in order to stand up under the marine service. The mechanisms are positive and quick in action; less than a quarter inch movement in the door actuates the switch and makes or breaks the circuit.

They are made in two types, termed direct acting and indirect acting. In the direct acting the plunger impinges directly against the door. In the indirect acting the door actuates a lever plunger protected by a spring against sudden slams or shocks. Both types are adjustable for any direction of conduit entrance, and may also be adjusted for varying widths of door frame.

They are manufactured by the Benjamin Electric Manufacturing Company, 806 West Washington Boulevard, Chicago, Ill.

Flexo Split Handle for Portable Lamp Guards

A special "Flexo" split handle has been put on the market by the Flexible Steel Lacing Company, of Chicago, Ill., which may be attached to the portable lamp guards manufactured by that company.

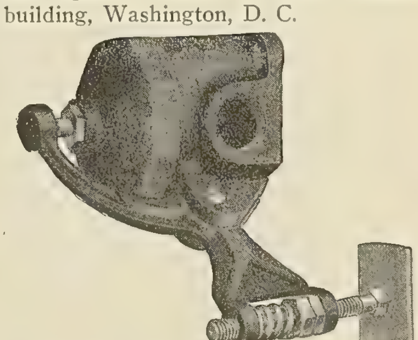


Adjustable Lamp Guard

The halves of the guards, including the handle itself, open wide from the hinge at the bottom, and can be instantly closed and locked around the switch at the end of any extension cord. The cord itself runs through the grooves in the handle.

National Merchant Marine Association Opens Washington Office

The National Merchant Marine Association, composed of men prominent in the shipbuilding and ship operation field, has opened offices at 1111 Munsey building, Washington, D. C.



Watertight Door Switch for Indirect Action

As has been previously noted this association has been formed to develop the possibilities of the American merchant marine. William Allen is now serving as acting secretary.

Marine Construction News of the Month

Ships, Shipyards and Shipyard Improvements—Terminal Projects—Launchings—Government Contracts

NEWS OF SHIP CONTRACTS

The Skinner & Eddy Corporation, Seattle, Wash., has received a reinstatement on contracts to build 25 steel vessels for the Emergency Fleet Corporation.

The Norwegian-American Steamship Company, 8 Bridge street, New York, it is reported, has placed a contract for two modern freighters of 9,500 deadweight tons with Napier & Miller, Glasgow, Scotland.

The Wisconsin Shipbuilding & Navigation Company, offices 214 West Water street, Milwaukee, Wis., yards, Kewaunee, Wis., has received a contract to build two 1,000-ton freighters.

The Newport Shipbuilding Corporation, Newbern, N. C., has received a contract to build 9 concrete river steamers for the War Department.

It is reported that the Todd Dry Dock & Construction Corporation, Tacoma, Wash., will receive a reinstatement from the Government on twelve steel ships on which contracts were suspended as the result of the shipyard strike in Tacoma.

It is reported that Swan, Hunter & Wigman Richardson, Ltd., Wallsend-on-Tyne, England, has received a contract from the Cunard Line for the construction of a 600-foot passenger steamer with a deadweight of about 12,500 tons. The vessel is to be fitted with geared turbines.

The Bayles Shipyard, Inc., Port Jefferson, N. Y., has signed a contract to build a 1,200-ton deadweight single screw steel oil tanker "for American interests."

The Coastwise Shipbuilding Company, Baltimore, Md., has received a contract to build a wooden schooner for the Chesapeake & South American Transport Company, Baltimore, Md.

It is reported that the National Shipbuilding Corporation, 202 Canal Bank building New Orleans, La., has received a contract from the Pan-American Transportation Company to construct three river oil barges, and that the company has also been awarded the contract for building four self-propelled steel semi-oceangoing barges to be built for the Cuyamel Fruit Company.

The Nyack Shipbuilding Corporation, Nyack, N. Y., has received a contract to build an 18-foot sailing boat and a 20-foot motorboat, to be used at the lighthouse at Tompkinsville, Staten Island, N. Y. The former will cost $527 and the latter $1,303.

The Alabama Dry Docks & Shipbuilding Company, Mobile, Ala., has received a contract for repairing the 2,206-ton oil tanker *San Antonio*. The contract will probably aggregate about $100,000.

D. Murphy, Kingston, N. Y., has received a contract for building twelve covered barges, 103 feet by 33 feet by 9 feet, for the Edward J. Barton Lighterage Company, 1 Broadway, New York. No machinery will be installed on these boats.

The Carteret Ferry Corporation, Linoleumville, S. I., N. Y., is building two four-mast wooden schooners.

Installation of machinery on eight seagoing tugs being built by M. M. Davis & Sons, Solomons, Md., is being carried out by H. E. Crook Company, Baltimore, Md.

Sunde & d'Evers Company, Seattle, Wash., has received a contract for outfitting three four-mast sailing schooners now being built at the Cholberg shipyard, Victoria, B. C., for Captain H. C. Hansen, Portsgrund, Norway.

The Cape Cod Shipyard, Wareham, Mass., is building an 80-foot twin-screw wooden passenger vessel, which will be operated by gasoline motors. Frederick K. Lord, 120 Broadway, New York, is the designer.

The Concrete Ship Molding Company, Seattle, Wash., is building a full-rigged sailing vessel for private interests.

Three 500-ton wooden barges are being built by the Samuel Beskin Shipbuilding Company, Peekskill, N. Y.

The Howard Shipyards & Dock Company, Jeffersonville, Ind., with yards at Paducah, Ky., has received a contract to build 10 oil barges.

Probably the last cancellations of contracts for wood vessels were received on March 27 at Astoria, Ore., when contracts for nine vessels were canceled at the McEachern Ship Company, three at the Wilson Shipbuilding Company, and four at the George F. Rodgers & Company plants.

Bids Solicited on Battleships

According to a statement issued by Franklin D. Roosevelt, acting Secretary of the Navy, on April 4, proposals for the construction of two battleships, Nos. 53 and 54, will be received until May 21, 1919.

Fire Boat for Jacksonville

The city of Jacksonville, Fla., is about ready to purchase a fire boat. Construction details are not yet determined. J. Everts Merrill is secretary of the city commission.

NEW SHIPBUILDING PLANTS

Wisconsin Shipyard Receives Contracts

E. T. Thomas, president of the Wisconsin Shipbuilding & Navigation Corporation, with yards located at Kewaunee, Wis., and offices at 214 West Water street, Milwaukee, Wis., announces that the company has accepted an order for two 1,000-ton steel freight and passenger vessels of sixteen knots. These two ships, a part of ten ships forming a line between North and South America, are to be delivered in November 1919. The vessels are to be fabricated from materials prepared by outside shops.

Good headway is being made on the construction of the plant, a special feature of which is the adoption of the Thomas drydock system, approved by leading marine engineers as a practical and correct way of handling ships. By means of a cradle, ships to be repaired can be transferred to a shore dock. No actual repair work will be carried on while the ship is on the drydock.

New Western Shipbuilding Plant

The organization of the San Francisco Open Dry Dock Company, with a capitalization of $2,000,000, has been begun through the filing of articles of incorporation. The site of the plant is located between the army transport docks at Fort Mason and the exposition site. The new plant will include a wharf 58 by 1,100 feet, with two slips 200 feet wide, a floating drydock, composed of wood and concrete, of 8,000 tons, warehouses, office buildings and machine shops. W. H. Kearney, C. H. Kearney, F. P. Parker, J. W. Machado, A. T. Briggs, P. A. Breen and I. L. Steinman are the incorporators.

Contract Let for $2,000,000 Shipbuilding Plant

Norton, Bird & Whitman, Munsey building, Baltimore, Md., are completing the preliminary plans of a large ship repair works which they have been engaged to build at Spring Garden. The repair yard will consist of shipways, drydocks, plate, angle, foundry and machine shops, a general construction building, a warehouse, etc. The plant will be fully equipped, it is reported, to carry on repair and construction work on steel vessels. The initial cost of the plant will probably be about $2,000,000.

New Ship Repair Shop at Wilmington, Del.

Simultaneously with the report of Charles Warner, chairman of the Board of Harbor Commissioners of Wilmington, Del., on the progress made for a new harbor and terminal for Wilmington, as the result of consultations on the project in Washington, is the announcement that a large ship repair plant will locate in Wilmington, provided the harbor project becomes a reality. The proposed plant would cost between $4,000,000 and $5,000,000, it was said.

New Ship Repair Shop

The Baltimore Marine & Iron Works, Inc., is the name of a corporation which has been established, with a capital of $50,000, at Clement and Woodall streets, Baltimore, Md., for the repair of ships and for the construction and repair of marine and stationary boilers. The company plans to build a machine and boiler shop.

Tampico to Have Shipbuilding Plant

A shipbuilding yard has been established at Tampico by the Laguna Transportation Company, which has built a shipway and installed machine shops and other necessary equipment. Mr. R. S. Dillman is in charge of the new department of the company, which intends, in addition to building and repairing barges and launches for its own use, to do general contract shipbuilding.

New Shipbuilding Enterprises

The Chicago Bridge & Iron Works, Washington Heights, Ill., is planning to build a steel barge plant on a five-acre site in South Chicago. Here, coaling barges 110 feet long and of 500 tons capacity will be built for the United States Navy.

McCay Brothers, Daytona, Fla., will erect a shipbuilding plant at West Palm Beach, Fla., to build wooden vessels 150 feet long, of five-foot draft. The plant will install woodworking machinery.

The Great Lakes & Ocean Transportation Company, Wilmington, Delaware, has been incorporated, with a capital of $2,000,000, to build and operate boats and to carry on a business as ship brokers.

The Deep Water Ship Company, Dover, Del., has been incorporated, with a capital of $100,000, for the building and operating of vessels.

A feature of the March record was the organization of three large drydock companies. The Clinton Dry Docks, Inc., was chartered in New York, with an authorized capital of $2,000,000; the Savannah Dry Dock & Repair Company, in Delaware, with an authorized capital of $1,500,000, and the Delaware Drydock & Shipbuilding Company, in the same State, at $1,000,000.

SHIPYARD EXTENSIONS

Lane Life Boat Company Enlarges Plant

The C. M. Lane Life Boat Company, 246 Huron street, Brooklyn, N. Y., has just completed a new factory building, with offices and garage additional, which will be utilized for wood work in connection with the present plant, which covers an area of more than 100 by 400 feet. The company is now equipped to furnish power lifeboats and the Engelhardt collapsible lifeboat, also metallic and wooden lifeboats on a larger scale.

Accessory Buildings

The Bethlehem Shipbuilding Corporation, Sparrow's Point, Md., is planning the erection of a two-story rivet storage shop to cost about $30,000.

The Simpson Dry Dock Company, East Boston, Mass., is planning to build a one-story brick machine shop.

The Union Iron Works Company, Norfolk, Va., it is reported, is in the market for new equipment.

The Atlantic Basin Iron Works, Summit avenue, Brooklyn, N. Y., is planning to build a one-story addition to its forge shop to cost about $45,000.

Hughes Foulkord Company, 1406 Commonwealth Building, Philadelphia, Pa., has entered the lowest bid for building a spar shop at Portsmouth, N. H., at $62,000.

$1,000,000 Drydock at Kingston

The Kingston Shipbuilding Company, Kingston, N. Y., is planning, with the co-operation of the Emergency Fleet Corporation, to build a 20,000-ton floating dry dock at that place to cost about $1,000,000.

Marine Railway for Astoria, Ore.

Thomas Bilyeu, manager of the Astoria Marine Iron Works, Astoria, Ore., has announced that the company will build a marine railway capable of handling ships up to 6,000 tons deadweight, to be built on the Young's Bay property under the direction of the United States Shipping Board. The new marine railway will cost about $500,000.

The company has acquired 500 acres of land on Young's Bay, it is reported, with a frontage of 12,000 feet, upon which will be erected a steel and ironworking plant.

Moore Shipbuilding Company Builds 12,000-Ton Drydock

The Moore Shipbuilding Company, Oakland, Cal., is about ready to construct a wooden floating drydock with a capacity of 12,000 tons. The dock will be composed of four pontoons. Contracts for the necessary dredging, piling, etc., are now being placed. The company also contemplates the construction of two marine railways, capable of docking vessels up to 5,000 tons capacity.

PORT IMPROVEMENTS

Astoria, Ore., Lets Terminal Contract

J. A. McEachern Company, Astoria, Ore., has received a contract to build a warehouse on Pier 1 of the port dock of Astoria, the price of which is $33,775. The Astoria Port Commission tentatively approved the plans for the construction of Pier 3 and warehouse. This pier will be 2,200 feet long and 300 feet wide. The estimated cost of the construction is $981,600. The complete harbor development will include eleven piers averaging 2,200 feet in length.

At present the development at Astoria represents $1,125,000. The total authorized expenditure is $3,128,300. Provision is made in these plans for a 15,000-ton drydock, to be located at the head of Slip 2.

Bids for Philadelphia Piers Announced

Bids were opened on March 27 for the construction of piers Nos. 82 and 84, South Delaware wharves, Philadelphia. Arthur McMullen Company, 149 Broadway, New York, entered the lowest bids, for pier No. 84, $898,000, for pier No. 82, $855,000. The work, covering the costs of dredging, filling, and other supplementary work, according to the bid of Arthur McMullen Company, amounts to $2,266,400.

Bids will be received in May for the construction of the 300-500-foot Penn Treaty pier by the Philadelphia Harbor Commission. G. W. Webster, Bourse Building, Philadelphia, Pa., is the engineer in charge of the work.

Seattle Piers Assured

Bids have been accepted by the National City Company, of New York and Seattle, Wash., for $500,000 worth of Seattle improvement bonds, which will insure the commencement of work on the new Smith Cove unit. This new pier will be equipped with the most modern freight and cargo-handling machinery. Preliminary dredging at the site has already been commenced by the Tacoma Dredging Company.

The Seattle Port Commission, Seattle, Wash., has authorized the purchase of a 35-ton electric crane from the Ohio Locomotive Crane Company for $25,766, with an additional cost of $2,959 for fitting the apparatus with an electric hoist magnet. The Northwest Bridge & Iron Company, Portland, Ore., was allotted the contract for building a 10,000-barrel steel tank, which is to be erected on the Smith Cove wharves.

Details of Charleston, S. C., Dry Dock

Although bids have not yet been solicited for the erection of the No. 2 drydock, which will be built under the supervision of the Bureau of Yards and

Docks, Navy Department, Washington, D. C., the following details concerning the construction are now available.

The work involves extensive excavation work and dredging in the preparation of the site, installation of piping, erection of a bulkhead, cofferdam and other temporary structures, together with building the drydock proper, which will consist of 180,000 cubic yards, concrete, pump well, suction chamber, railroad tracks, crane tracks with supporting concrete construction, culverts and sluices, with hydraulically operated valves, keel blocks, bilge blocks, including slides with fitting capstans, and other construction work. About $3,500,000 will probably cover the cost of the construction.

Will Enlarge Mare Island Navy Yard

Although $2,500,000 is being expended in the development of Mare Island navy yard at present, the yard officials are planning a greater development of this base. In expectation of keeping one-half of the American fleet on the Pacific coast, appropriation of $1,700,000 has been asked for dredging and deepening of the channel at this yard as a preliminary step toward the enlargement.

Plan to Enlarge Bremerton Naval Base

The naval affairs committee of the House of Representatives, after their tour of the Bremerton naval base, Bremerton, Wash., reported that they believed an expenditure of at least $8,000,000 should be utilized to develop the Bremerton naval base to its fullest capacity. Of this amount $400,000 has already been appropriated. As soon as the extension work is begun at the yards, local officials plan the building of a 400-foot wharf, to provide for the unloading of scows, a big warehouse for freight and small bunkers for coal.

$1,000,000 Oil Terminal

The Texas Oil Company is planning to build a large oil plant at Chotaw Point, Mobile. Piers will be built for the accommodation of oil barges, which will be supplied with adequate bunker facilities and sufficient pipe lines. The holding tanks will have a capacity of 64,000 barrels each. About $1,000,000 will be expended in the development.

The Standard Oil Company, Baltimore, Md., is planning to build a six-story concrete warehouse on the west side of Pier 2, at Pratt street, to cost about $200,000.

Plan $3,500,000 Drydock at Vancouver

A Seattle concern has submitted a proposal to the Provincial Government of British Columbia, at Victoria, B. C., for the construction of a steel drydock, of 25,000 tons lifting capacity, on the condition that the Province should guarantee the principal and interest of the bonds issued up to 55 percent of the cost, the Provincial Government to hold the first lien on the property. The estimated cost of the drydock would be $3,500,000.

The Dominion Government under its drydock subsidy guarantees for thirty-five years payment annually of 4½ percent of the actual cost of construction. In the event of failure on the part of the company which proposes the construction, the Provincial Government would in that case own the property for 55 percent of its cost, and the Dominion Government's subsidy would still be operative. As yet no final action has been taken.

Gantry Cranes for Providence

The city of Providence, R. I., is contemplating the installation of efficient cargo-handling machinery at that port. City Engineer Bronsdon has been instructed to draw plans for the installation of six and eight 2-ton gantry cranes on the municipal dock.

Terminal Appropriations

A bill was signed on April 7 providing $6,800,000 for the development of terminal facilities along the New York State barge canal. The Assembly Rules Committee also recommended the bill appropriating $950,000 for the construction of terminals at Newburgh, Kingston, Poughkeepsie and Yonkers.

The city of Portland, Ore., is about to issue $1,250,000 of harbor development bonds, to be expended in the further development of the St. John's Municipal Terminal.

An appropriation for $830,000 for the improvement of Los Angeles and Long Beach harbors has been approved by the ways and means committee of the California State Legislature.

The city of New Orleans is spending $14,000,000 in the improvement of municipal docks. At present over 10,000 men are employed in the work.

The city of Orange, Tex., is about to build wharves and docks which will cost $150,000.

The city of Portland, Ore., is still working on a project to build a 12,000-ton drydock. It is now estimated that this structure will cost about $1,250,000.

Government Contracts Awarded

The Bureau of Yards and Docks, Navy Department, Washington, D. C., has awarded the following contracts: The construction of a wet basin at Pensacola, Fla., to the Newport Engineering & Contracting Company, Newport News, Va., for $47,100; the installation of an electric traveling crane at the storage shed, Boston, Mass., to the Bedford Foundry & Machinery Company, Bedford, Ind., for $8,980.

Contract has been let to Harry Cotton for the construction of a $30,000 concrete dock at Fort Flagler.

The Bureau of Yards and Docks, Navy Department, Washington, D. C., has let a contract to Havery & Company, 517 South Los Angeles street, Los Angeles, Cal., for building a gasoline storage and supply system at San Diego, Cal., to cost $15,875.

The Aberthaw Construction Company, Boston, Mass., has received a contract to build twelve storage buildings at Aberdeen, Md., at the cost of $450,000.

W. L. Miller & Co., 171 Alford street, Boston, Mass., has received a contract for building a concrete quay wall and fill at Newport, R. I., to cost $133,739.

Contract has been let to E. S. Downs Company, 9 Campbell street, Newark, N. J., for electrical work at Ward's Island, N. Y., to cost $3,640.

C. L. Creelman has been awarded the contract for making a 250-foot addition to the Tracy street terminal, Seattle, Wash.; $30,989 is the amount of the expenditure. It has been recommended that the bid of Wellman-Seaver-Morgan Company to supply a gantry crane for Smith-Cove terminal for $87,700 be accepted.

Contract has been let by the Bureau of Yards & Docks, Navy Department, Washington, D. C., for the construction of a wood pier at Norfolk, Va., to the Boyle-Robertson Construction Company, Washington, D. C., to cost $156,207.

Bids have been opened by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the building of a water tank at Newport, R. I. The Pittsburgh-Des Moines Steel Company, 959 Munsey building, Washington, D. C., entered the lowest bid of $11,760.

The National Contract Company, Evansville, Ind., has received a contract to build lock and dam No. 30 on the Ohio River. The work will cost $636,446.39. The Dravo Construction Company, Pittsburgh, Pa., was the next highest bidder.

The Bureau of Yards and Docks, Navy Department, Washington, D. C., has awarded the following contracts: For the installation of turbo-alternators at Washington, D. C., to Baker-Dunbar-Allen Company, Philadelphia, Pa., $10,180; for the installation of coal and ash-handling equipment at New York to the Specialty Engineering Company, Philadelphia, Pa., $24,825.

Industrial Piers

The Denero Realty & Manufacturing Company, 6900 South Broadway, St. Louis, Mo., is planning to build a dock and an addition to cost about $150,000. C. E. Hayden, 3400 Maury avenue, St. Louis, Mo., is in charge of the work.

The Eastern Wisconsin Electric Company, 428 North Eighth street, Manitowoc, Wis., plans to build a modern dock to cost about $150,000. The Kelsey Brewer Company, La Crosse, Wis., is in charge of the work.

The Huntsville Gin & Wharf Company, Huntsville, Tex., has let a contract to W. H. Randolph for the construction of a cotton wharf and accessory buildings, to cost about $30,000.

Future Government Work

The Bureau of Yards and Docks, Navy Department, Washington, D. C., may be addressed concerning specification for the power plant improvements at Pearl Harbor, T. H., to cost about $80,000.

Bids were opened on April 20 by the Lighthouse Superintendent, Boston, Mass., at the Lighthouse Depot, Chelsea, Mass., for building a new sea wall and wharf.

The United States Engineer Office, Philadelphia, Pa., will receive proposals until May 8 for the construction of a marine railway at Fort Mifflin.

The Bureau of Yards and Docks, Navy Department, Washington, D. C., has invited bids on the building of ten buildings at Yorktown, Va., at an estimated cost of $177,500, also filling and dredging at Norfolk, Va., to cost about $500,000.

Louis Nixon, superintendent of Public Works, Albany, N. Y., will receive bids until April 29 for the building of a barge terminal freight shed on Pier 93, West Fifty-third street, New York. About $53,969 is involved in the contract.

The Bureau of Yards and Docks, Navy Department, Wash., D. C., is planning to install reciprocating air compressors at the Bremerton naval base, Washington, to cost about $62,000.

The Bureau of Yards and Docks, Navy Department, Washington, D. C., invites proposals on the following projects: Installation of six electric bridge cranes at the extension of the machine shop and foundry, Boston Navy Yard, $175,000; installation of six I-beam electric traveling cranes at the Torpedo Assembling Plant, Alexandria, Va., $10,800; building a concrete quay wall and fill at the Naval Training Station, Newport, R. I., $100,000.

The three-story building to be erected by the Bureau of Yards and Docks at Annapolis, Md., will be built by Levering & Garrigues, New York, who have submitted the lowest bid of $800,000. The building is to be 60 by 370 feet.

The Country's Drydock Capacity Increasing

The fifth section of the drydock which is being built for the Skinner & Eddy Shipbuilding Company, Seattle, Wash., has been completed by the Port Blakely Mill Company. This unit gives the plant the largest unit drydock in the Northwest, since it will be able to accommodate 15,000 tons or more when ready for operation.

The fourth section of the drydock of the Morse Dry Dock & Repair Company, Brooklyn, N. Y., was floated on April 2. The six-section floating drydock will be 19,000 tons, and will accommodate ships of 30,000 tons and up to 750 feet long.

The George Leary Construction Company, which recently completed a 1,000-foot drydock at the Norfolk Navy Yard, is now building two 400-foot docks at the same location. One of these is about 75 percent complete.

The Jahncke Company, New Orleans, La., announces favorable progress in the building of the 10,000-ton drydock on the Industrial Canal. The use of this drydock and the 16,000-ton drydock at the Algiers naval station will enable New Orleans to handle the largest vessels, and will greatly relieve the overcrowded repair plants on the Gulf.

Five of the seven pontoons being fabricated by the Texas Carnegie Steel Association, Galveston, Tex., are about completed. This 10,000-ton floating dry dock is being constructed for the Galveston Dry Dock and Construction Company, Galveston, Tex.

The Valk & Murdock Dry Dock Company, Charleston, S. C., has received its first repair work on its new drydock, taking on a 4,300-ton Swedish vessel. This is the largest drydock south of Cape Hatteras. Only four sections are now in operation; when the six sections are installed the drydock lifting capacity will be 7,500 tons, and it can accommodate vessels 450 feet in length.

Pearl Harbor Dry Dock Completed

A 1,029-foot floating drydock has recently been completed at Pearl Harbor, Honolulu, T. H. The construction, which has involved the expenditure of about $4,500,000, was under the supervision of the Bureau of Yards and Docks, Navy Department. Since the cofferdam method of construction was not practical, the entire dock was constructed in sixteen sections on floating drydocks. The dock will be ready to receive warships in about sixty days. Work was begun upon the construction by the San Francisco Bridge Company in July, 1909.

New $4,000,000 Drydock at Quincy Point, Mass.

S. W. Wakeman, manager of the Fore River plant of the Bethlehem Shipbuilding Corporation, Bethlehem, Pa., is urging the construction of a floating drydock at Quincy Point, Mass. Roughly, the new construction will cost between $4,000,000 and $5,000,000. The plan calls for a sectional drydock with accommodations for two 500-foot ships of 10,000 tons each, or one 18,000-ton ship averaging 700 feet in length.

Maritime Works Destroyed

Nearly half the maritime works of Monfalcone, sixteen miles northwest of Triest, have been destroyed by fire.

Superdreadnought Tennessee Launched April 30

The superdreadnought *Tennessee*, which is under construction at the New York Navy Yard, was launched on April 30.

GENERAL SHIPYARD NEWS

Output of the American Ship-Building Company

On March 26 the directors of the American Shipbuilding Company, Cleveland, O., declared a regular quarterly dividend of 1¾ percent, and an extra cash dividend of 2¼ percent on the common stock. The American Shipbuilding Company, at its six Lake yards, has orders for 111 steamers, 45 of which will be completed and ready to leave for the coast when navigation opens.

Bethlehem Steel Corporation Plans Further Enlargement of Sparrow's Point Plant

The April report of the Bethlehem Steel Corporation, which will be presented to stockholders during the month, states that during this year about $20,000,000 will be spent at the Sparrow's Point steel plant.

When this industrial development is completed an investment of $50,000,000 will be made productive. The corporation will be in a position to produce an annual capacity of over three million tons of steel ingots, and since the development of shipbuilding plants has kept pace with the steel plants in capacity and equipment, they are prepared to build vessels of any type or size.

The Bethlehem Shipbuilding Corporation's plants delivered 625,000 deadweight tons of merchant shipping from the date war was declared to the close of 1918, which represents about 22 percent of the output of the entire country during this period. This tonnage does not include 26 torpedo boat destroyers and 16 submarines delivered during 1918, or 36 destroyers launched and fitted out during 1919.

New York Shipbuilding Corporation's Report Shows Growth

The annual report of the New York Shipbuilding Corporation, Camden, N. J., was made public on April 7.

Fifteen steamers were completed during the year, aggregating 120,000 tons deadweight. Seven naval vessels were launched during the year, and thirteen were on the ways and ten more in the shops on December 31.

The financial statement of the company shows a gross profit of $2,624,647, compared with $1,167,404 in 1917.

Standifer Plant at Vancouver to Be Permanent

James McKinlay, who was general manager of the G. M. Standifer Construction Corporation's shipyard on the Columbia River, has been appointed yard manager at the Vancouver plant. J. A. Sim, who planned the Vancouver yards, continues as general manager. This is in line with the company's plan to establish the Vancouver yards on a permanent basis.

Expenditure at Philadelphia Navy Yard

Details of the enlargement of the Philadelphia Navy Yard, which will entail the expenditure of about $20,000,000, are given out as follows: The building of a 1,064-foot drydock, $5,000,000; the building of two new 900-foot ways, a large structural machine shop, and smaller pattern and machine shops, $3,000,000; the construction of the naval aircraft building, $5,000,000. The daily pay roll of the yard amounts to $51,000.

New York Shipbuilding Company Holds Contract for Nine 13,000-Ton Vessels

The New York Shipbuilding Corporation, Camden, N. J., now employing 14,000 workers, is building hulls Nos. 240, 241 and 242, which are the largest vessels under construction in the United States. The length of these combination passenger and cargo vessels is 535 feet, with 72-foot beam and a molded depth of 50 feet. The allowable draft is 30 feet 6 inches. The vessels, which have a displacement of 21,000 tons and a deadweight tonnage of 13,000 tons, will be equipped with twin-screw propellers, driven by two Westinghouse double reduction geared turbines, developing 12,000 horsepower. Steam is generated by batteries of Babcock & Wilcox boilers of the watertube type fired by oil fuel.

When in operation the vessels will accommodate 500 cabin passengers, and as many steerage passengers as may be desired up to 1,000. In addition 9,000 tons of cargo can be handled. For present use, however, as transports, the vessels will accommodate 3,500 troops, including regular quota of officers, military equipment and stores. The company also holds a contract for six more vessels of the same type, work upon which has not yet been begun.

Layton Company Completes Nine Government Barges

The B. Layton Company, Quincy, Ill., has just completed a Government contract for the building of nine barges. These barges, which are 120 feet long, 30 feet wide, 8 feet deep, and have a capacity of 250 tons each, will be utilized by the Navy Department in coaling service on the Atlantic seaboard.

Construction Work on Concrete Tankers

The Pacific Marine & Construction Company, San Diego, Cal., will be ready on May 1 to pour the concrete into the molds of the 7,500-ton oil tankers being built at those yards. Shipments of larsite are being received at the yards. The total quantity of concrete used for one tanker is 2,700 cubic yards. The new clay aggregate weighs 110 pounds to the cubic foot, as against 150 pounds for ordinary concrete. This material gives 4,000 tons as the weight of the concrete in the vessel,

Eastern Shore Shipbuilding Corporation's Plant for Sale

The shipyard of the Eastern Shore Shipbuilding Corporation, with offices at 2 Rector street, New York, and plant at Sharptown, Md., as noticed in the NEWS SUPPLEMENT of March 28, will be subject to a receiver's sale on May 15 at 10 A. M.

The plant, which is in full operation by the receivers, has seven vessels under construction. Within the last eighteen months the entire plant has been remodeled and up-to-date machinery and equipment installed. Six shipways are provided, with a capacity to build vessels of 6,000 tons; the ways front on deep water.

Shipyards Expanding

The Chester Shipbuilding Company, Chester, Pa., has commenced the erection of the one-story addition at Front and Kerlin streets. The structure will be about 37 by 140 feet, and will be equipped for assembling operations, providing for increased operations in this department of the plant.

The Biloxi Dry Dock & Shipbuilding Company, Pascagoula, Miss., is now giving employment to close to 175 men at its local yards, with payroll aggregating about $25,000 per month. The company is specializing in the construction of wooden vessels. The plant is being devoted to the production of a number of three-masted wooden schooners about 147 feet over all in length.

The Greenport Basin & Construction Company, Greenport, L. I., is operating its local shipbuilding plant, known as the Liberty Yard, for the construction of a number of barges for the Government. The company has a contract for seven boats of this type, each about 110 feet long, the first of which has now been launched. In the coming months a portion of the yard capacity will be devoted to overhauling and repair work, to include a number of submarine chasers, and construction of an entire new hull for a large steamer.

The Ambursen Construction Company, 61 Broadway, New York, N. Y., will soon complete the first concrete barge at its shipyard at Little Ferry, N. J., for the Navy Department. The company has a contract for a number of such boats for the Government, each about 36 feet wide and 125 feet long. It is planned to inaugurate construction on a second such barge at an early date.

Rapid progress is reported in the construction of the new marine railway being located at the naval coaling station at La Playa, Cal., by the Ross Construction Company. The railway will probably be completed by January 1, 1920. It will cost about $250,000.

The Bayles Shipyard, Inc., Port Jefferson, L. I., is now engaged in the construction of four steel vessels for the Government, consisting of two boats of about 5,000 tons capacity, and two ocean-going tugs. Following the completion of these vessels, the yard will be used for the building of steel vessels for private interests, with plans under way for the construction of an oil tank vessel of about 1,200 tons capacity.

The Johnson Iron Works, New Orleans, Louisiana, is constructing a steel transfer barge, to be used in connection with the towboats and barges which are being built to carry coal and freight on the Warrior Barge Canal. This barge will be equipped with fast-hauling devices, and will move under its own power to any wharf or steamship pier within New Orleans harbor to effect rapid transfer of freight.

George Gordon Crawford, president of the Chickasaw Shipbuilding Company, Mobile, Ala., reports that the keel for the second 9,600-ton steamer will be laid as soon as the steel is fabricated. Eight ships will be under construction as soon as the ways are ready, four ways having already been completed.

A. H. M'Leod & Company, Jacksonville, Fla., which has been handling large contracts for the United States Shipping Board for awning, tent work, ship rigging, etc., is now in a position to take on new contracts. The plants at Mobile and Pensacola were also utilized during the war for the Shipping Board orders.

According to an announcement of Naval Constructor Henry N. Gleason, head of the hull department, Mare Island, Cal., the cost of the hull of the battleship *California*, which is being built at the Mare Island yards, will be from $500,000 to $1,000,000 less than the contract price. This cost, it is reported, is considerably less than the cost of the *Tennessee*, which is being built at the New York navy yard.

Pusey & Jones Receivership Denied

An application for a receivership for the Pusey & Jones Company, with shipyards at Gloucester, N. J., and Wilmington, Del., was filed in the Federal Court on April 18 by Bleakly Bros., Camden, N. J.,

When the issue was brought up for discussion before Vice-Chancellor Lane, Newark, N. J., on April 22, the application of the Eastern Trucking Company, one of the creditors, for the appointment of a receivership was denied.

An officer of the company is reported as saying, "From our standpoint the Emergency Fleet Corporation is at fault. The corporation has not been willing to advance funds on materials until they are actually put into the ships."

Receivers for Groton Iron Works

P. Leroy Harwood, of New London, Conn., and Frederick Congdon, of Boston, Mass., have been confirmed as permanent receivers for the Groton Iron Works, Groton, Conn.

The defendant, a subsidiary of the United States Steamship Company, 50 Broad street, New York, is indebted to the latter to the extent of $800,000.

RECENT LAUNCHINGS

The oil tanker *Romulus*, which is being constructed by the Bethlehem Shipbuilding Corporation, at its Harlan plant, Wilmington, Del., for the Vacuum Oil Company, has been launched.

The American International Shipbuilding Corporation, Hog Island, Pa., launched the vessel *Schoodic*, under construction for the Emergency Fleet Corporation, on March 29.

The Northwest Steel Company, Portland, Ore., launched the 8,800-ton cargo vessel *West Celeron*, which it is building for the Emergency Fleet Corporation, on March 28.

The Adams Shipbuilding Company, East Boothbay, Maine, has launched the tug *Clara H. Doane*, which is being built for Crowell & Thurlow, Boston, Mass.

The Baltimore Dry Docks and Shipbuilding Company, Baltimore, Md., launched the unnamed hull No. 92 on March 29. The vessel is one of the cargo steamers being constructed for the Emergency Fleet Corporation.

The Greenport Basin & Construction Company, Greenport, Long Island, N. Y., has recently launched its seventh 1,200-ton barge for the Government. The company is also rebuilding the fishing steamer *Quickstep* at a cost of $85,000.

The Gulf Shipbuilding Company, Mobile, Ala., launched the four-mast schooner *Ville de Dixmude*, of 2,500 tons, on March 15.

The sixth vessel, the *Clio*, built by the Pacific American Fisheries, South Bellingham, Washington, was launched on March 22. The *Clodia*, the last vessel to be built for the United States Shipping Board by that company, was launched on March 31.

The ocean-going tug *Basswood* was launched on April 5 at the Bayles Shipyard, Inc., Port Jefferson, L. I. This is the first steel vessel to be launched at a Port Jefferson yard.

The French trawler *Mondoir* was launched at the Savannah yards of the Foundation Company, 233 Broadway, New York, on March 26.

The Biloxi Dry Dock & Shipbuilding Company launched the schooner *Gabriella*, at Biloxi, Miss., on March 29.

The merchant vessel *Delungra*, of 5,000 tons, the first vessel to be constructed by the Australian Government under the commonwealth shipbuilding scheme, was launched on March 28 at Walsh island.

The steamer *West Cavanal* was launched by the Southwestern Shipbuilding Company, San Pedro, Cal., on March 20.

The city fire boat *Archie J. Ely* was launched on March 18 from the plant of the Marine Equipment Company, Los Angeles, Cal.

The Pacific Coast Shipbuilding Company, Suisun Bay, Cal., launched the second of ten 9,400-ton deadweight steel cargo carriers which the company is building for the Shipping Board on March 30. The vessel was christened the *Cansumet*.

Percy & Small, Inc., Bath, Me., launched on March 30 the five-masted iron strapped wooden schooner *Joseph S. Zeman*, a 3,200-ton vessel which the company is building for David Cohen & Company, Inc., 29 Broadway, New York.

The merchant vessel *Louis Luckenback* was launched on March 30 at the Fore River plant of the Bethlehem Shipbuilding Corporation, Quincy, Mass. The *Luckenback* is of 12,000 tons capacity, 537 feet in length and has the distinction of being the biggest merchant vessel ever launched in this country.

Two steel freighters, the *Knoxville* and *Louisville Bridge*, were launched on March 27 at the yards of the Submarine Boat Corporation, Newark Bay, Newark, N. J. The *Anniston* and *Chattanooga*, 5,500-ton cargo vessels, were launched on March 30, and the *Montgomery* on March 31.

The Submarine Boat Corporation, Port Newark, N. J., has launched the thirty-sixth steel vessel, *St. Augustine*, at the yard.

The Federal Shipbuilding Company, Kearny, N. J., launched the vessels *Donora* and *Waukegan* on March 31.

On March 18, David & William Henderson & Company, Ltd., Partick, Glasgow, launched the 400-foot steel screw steamer *Tremorvah*, which it is building for the Hain Steamship Company, St. Ives, Cornwall.

On March 29 three steel vessels were launched in Seattle, Wash.—one 8,800-ton steamship *West Hembrie*, by J. F. Duthie & Company; one 9,600-ton steamship *Edgmour*, by the Skinner & Eddy Company, and one 8,000-ton steamer *West Irma*, by the Ames Shipbuilding & Dry Dock Company.

One of the large freighters, the *Waukau*, was launched by the Merchant Shipbuilding Company, Bristol, Pa., on March 31. Unfortunately the breaking of the scaffold caused the death of several spectators.

The Housatonic Shipbuilding Company, Stratford, Conn., launched the 3,500-ton wooden ship *Isto* on April 3.

The Tacoma Shipbuilding Company, Tacoma, Wash., launched the 3,500-ton Ferris type wooden steamer *Fort Jackson* on March 27.

The Coos Bay Shipbuilding Company, Marshfield, Ore., launched the steamer *Pamunkey* on March 26.

The Moore Shipbuilding Company, Oakland, Cal., launched the 9,400-ton freighter *Cotati* and the 10,000-ton oil tanker *Imlay* on March 30.

The Richard T. Green Shipyards, Chelsea, Mass., has launched the 2,000-ton capacity barge *Nahant*, which it is building for the United States Shipping Board.

Grays Harbor Motorship Corporation, Aberdeen, Wash., launched the 4,000-ton twin-screw steamer *Mannahocking* on April 1 for the Emergency Fleet Corporation.

The Columbia River Shipbuilding Corporation, Portland, Ore., launched the steel ship *West Tonate* on April 2.

The Stockton Yards, Inc., Stockton Springs, Me., launched on April 2 the four-masted schooner *A. Ernest Mills*, which it is building for Crowell & Thurlow, Boston.

On April 5, the Wallace Shipyards launched the 4,300-ton vessel *Canadian Volunteers*, which is being built for the Imperial Munitions Board. The yards will lay keels for vessels of 5,100 tons in the future.

The Allen Shipbuilding Company, Seattle, Wash., launched the *Ahmik* on April 4. The vessel was originally designed for the installation of Machinery, but has been converted into a barge.

The Baltimore Dry Docks & Shipbuilding Company, Baltimore, Md., launched the steamer *Calvert* on April 5.

The Seattle North Pacific Shipbuilding Company, Seattle, Wash., launched the 9,400-ton steamship *Osaqumsick* on April 5.

The Mobile Shipbuilding Company, Mobile, Ala., launched the 3,500-ton composite ship *Oyaka* on April 5.

The twenty-second ship, *Startia*, was launched at the shipyards of the American International Corporation, Hog Island, Pa., on April 5.

The launching of the steamship *Worcester*, by the Groton Iron Works, Groton, Conn., occurred on April 5.

The twenty-first ship, the *Seekonk*, was launched on April 5 at the Hog Island yard of the American International Shipbuilding Corporation.

The American Shipbuilding Company, Brunswick, Ga., launched the 3,500-ton steamship *Bridgewater* on April 5.

The Bath Iron Works, Ltd., Bath, Me., launched the destroyer *Aaron Ward* on April 10.

The Traylor Shipbuilding Corporation, Cornwells Heights, Pa., launched the last 3,000-ton cargo carrier, *Seyton*, which it is building for the United States Shipping Board, on April 10.

The Bethlehem Shipbuilding Corporation, Ltd., Quincy, Mass., launched the destroyer *Morris* on April 12.

Oscar Daniels Company, Tampa, Fla., launched the 9,600-ton steamship *Wilscox* at Tampa, Fla., on April 19.

The Meacham & Babcock Shipbuilding Company, Seattle, Wash., launched the barge *Cardia* on April 10.

The Foundation Company, 233 Broadway, New York, launched the 3,000-ton steamer *Mulhouse* at their Victoria, B. C., yards on April 10.

The Northwest Steel Company, Portland, Ore., launched the 8,800-ton vessel *West Chana* on April 12.

The Buffalo Dry Dock Company, Buffalo, N. Y., launched the steamer *Lake Fugard* on April 12. The vessel had all her machinery, boilers and superstructure, aboard and in place at the time of the launching.

PERSONALS

Commander M. E. Reed, U. S. Navy, who has served as head of the Machinery Division of the Bremerton Navy Yard, has been ordered to Mare Island, Cal. Commander A. T. Church U. S. Navy, will succeed him at Bremerton.

A. A. Corey, general superintendent of the Homestead plant of the Carnegie Steel Company, has resigned to become president of the Cambria Steel Company, and vice-president of the Midvale Steel & Ordnance Company. J. S. Oursler will succeed him at the Homestead plant.

P. A. S. Franklin, president of the International Mercantile Marine Company, has left for Europe.

William M. Brittain, secretary of the American Steamship Association, has left for Europe in an advisory capacity for the United States Shipping Board.

James V. Converse has been appointed temporary secretary of the Shipping Board, to fill the place left vacant by the resignation of Lester Sisler.

Captain W. M. Hunt has been named marine superintendent of the Hampton Roads district of the United States Shipping Board.

M. Scarth Stevenson, Molsons Bank, Montreal, and Chandler M. Wood, president of the Metropolitan Trust Company, Boston, Mass., have been elected directors of the National Shipbuilding Corporation, Camden, N. J.

Henry Lysholm, consulting engineer and naval architect, Stock Exchange Building, Philadelphia, Pa., has been engaged by the New York Shipbuilding Corporation, Camden, N. J., to expedite the building of the destroyers, contracts for which have been awarded to this company by the Navy Department.

A. H. Lawton, of Savannah, Ga., has been elected president of the Ocean Steamship Company, to succeed William H. Pleasants, of New York, who died March 18.

The Virginia Shipbuilding Corporation, Alexandria, Va., announces the resignation of Robert L. Lake, purchase and traffic manager, who resigns to take up his private business affairs.

John F. Blain, formerly district manager of the United States Shipping Board Emergency Fleet Corporation, has opened offices at 453 Coleman Building, Seattle, Wash., and announces that his services are available as agent, owner's representative or surveyor of any floating property, for account of owners, shippers or underwriters. Associated with him is a competent marine engineer familiar with survey work in connection with engines and boilers. Cable address, Blainco, Seattle.

At the resignation of Fred G. Ballin, president of the Pacific Marine Iron Works, John L. Jennings was elected president of the plant, with Joseph Supple, vice-president, and Arthur Langguth, secretary. Edward G. Gordon, of the machinery firm of Gordon & Finbeiner,

OBITUARY

Marshall Ten Broeck Davidson, president of the M. T. Davidson Company, steam pump manufacturers, located at 154 Nassau street, New York, died on April 10, at the age of 82. In 1857 he began work in a marine engineering machine shop, and later went to sea as an assistant engineer on ocean steamships. During the Civil War he became chief engineer of an army transport, building at Wilmington, Del., superintending the construction and installation of its machinery. Later he became chief engineer in the Revenue Cutter Service. At the close of the war he began building up the Davidson steam pump and pump engine business. During the present war his company has equipped United States battleships and destroyers.

Frederick Weber, of F. Weber & Company, 1125 Chestnut street, Philadelphia, Pa., died on March 18, 1919. Mr. Weber had been actively connected with the business for over fifty years.

Captain William Dixon Burnham, a director of the American-Hawaiian Steamship Company and prominent in maritime circles, died on March 28 at his home in Port Chester, N. Y., aged 74.

Robert Edmund Twohy, vice-president of Twohy Brothers, interested in the Seattle Northern Pacific Shipbuilding Company, Seattle, Wash., and the Pacific Car & Foundry Company, died in San Francisco on March 22.

Barry O. Jones, secretary and director of the Bethlehem Steel Corporation and the Bethlehem Shipbuilding Corporation, Ltd., died on April 3.

William J. Galbraith, builder and superintendent of the New Orleans yards of the Foundation Company, 233 Broadway, New York, recently died at his home in Montreal, Canada.

Side Launching of the *Cushnoc* at the Yards of the Pensacola Shipbuilding Company, Pensacola, Fla., on March 15

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A Challenge

AT this time a year ago, when the first vessel was launched from the Newark Bay Shipyard of the Submarine Boat Corporation, the great Government assembling yards for building so-called fabricated ships were just beginning to add their quota to the production of vessels in the United States. The *Agawam* was launched on May 30, 1918, and, during the twelve months since that date, the Submarine Boat Corporation has launched no less than fifty-two vessels, representing a deadweight tonnage of 278,000. The launching of an average of one ship a week during the year establishes, the builders believe, a world's record.

Can any other shipyard in this country, or abroad, produce a launching record which will equal or better that made by the Submarine Boat Corporation?

Ban on Foreign Contracts Removed

THE delayed action of President Wilson in rescinding the order which prevented American shipbuilders from taking foreign contracts disposes of at least one obstacle, which has made the immediate outlook for business in some of the shipyards rather gloomy. Six months ago, numerous inquiries from foreign shipowners indicated that several maritime nations were eagerly seeking an opportunity to build up their merchant fleets, which had been seriously depleted by the war. More recently this demand has fallen off, owing to the fact that orders could not be placed in American yards, but now that American yards which are not fully occupied with Government work may take foreign contracts, it is probable that a considerable volume of business will be offered, provided prices and deliveries are acceptable. While most of the larger American yards will not be in a position to take foreign business until next year, nevertheless, many of the smaller yards can offer shipbuilding facilities at once, and it is estimated that possibly two million tons could be handled without disarranging the Government programme.

Planning for the Future

WITH the opening of Congress a resolution has been introduced in the House of Representatives by the new chairman of the Committee on Merchant Marine and Fisheries calling for an investigation into the operations of the Shipping Board and the Emergency Fleet Corporation and the preparation at the earliest possible moment of such legislation as may be found advantageous, and necessary to promote the advancement of the American merchant marine. This is a step in the right direction. Until some definite marine policy is established, little progress can be made in the broad development of shipping interests. The chairman of the Shipping Board has already stated his opinion as to a feasible method of developing the merchant marine, which, while not faultless, has nevertheless served as a useful basis for starting an exhaustive discussion of the subject. Other opinions from individuals and representative organizations have been freely offered, and just as this issue goes to press a conference of shipping, shipbuilding, exporting, manufacturing and allied interests is about to be held in Washington to consider the future policy for operating the merchant marine. Bearing in mind that the time is at hand not only to plan, but to act, these activities should soon lead to the establishment of a definite workable plan, by which the American merchant marine can take its rightful place in the world's commerce.

A Momemtous Shipping Deal

AFTER months of extended negotiations, the directors of the International Mercantile Marine last month approved the sale of the vessels and assets of its British subsidiaries to a British syndicate at a price said to be approximately $130,000,000 (£27,000,000). As it is believed that the approval of the stockholders of the company will naturally follow at a special meeting to be held this month, this action is regarded as closing the biggest deal in the history of American shipping. Stripped of its British tonnage, which included the fleets of the White Star, Atlantic Transport, Leyland, International Navigation and other lines, totaling 763,837 gross tons, the International Mercantile Marine will have as basis for future development a fleet of eleven vessels, totaling 130,641 gross tons, and the enormous sum made available by the sale of the British ships. With the resources created by the Government during the war to draw from, consisting of millions of tons of new American ships, and the most extensive shipbuilding facilities in the world, the International Mercantile Marine, with its experience and resources, will be in a position to enter the new era of American shipping in a way which opens up vast possibilities for the future of the American merchant marine.

British Shipbuilding Far Behind American

LLOYD'S shipbuilding returns for the first quarter of 1919 show that the amount of merchant shipping under construction in the United States is twice that in the United Kingdom. The total amount under construction at the end of March in allied and neutral countries, is given by Lloyd's as 7,796,266 tons. Of this, Great Britain's share is 2,254,845 tons as compared with 4,185,523 tons in the United States. The tonnage under construction in the United States constitutes 75 percent of the total tonnage building outside the United Kingdom.

Comparing the above figures with the returns for June, 1914—the last quarterly period before the war—it will be found that, while figures for the United Kingdom have

been increased by about 500,000 tons, the tonnage building elsewhere has increased by more than four million tons. In reality, this increase is greater than would appear from the figures, as Germany and Austria were included in the earlier figures and not in the latter. As a matter of fact, the tonnage now under construction in the United States is more than twenty-eight times the amount under construction in June, 1914.

In spite of the relatively small increase in tonnage under construction in Great Britain, as compared with the pre-war period, shipbuilding conditions in Great Britain are considered favorable. British construction at present includes 603 steel steamers of 2,220,816 tons, besides 39 ferro-concrete barges, 1 motor vessel and 49 steel sailing ships. The number of large vessels under construction is considered a particularly favorable sign; 4 are between 10,000 and 12,000 tons; 8 between 12,000 and 15,000 tons; 6 between 15,000 and 20,000 tons, and 4 between 20,000 and 25,000 tons.

Following Great Britain, which stands second in the volume of merchant tonnage under construction, comes the British Dominions with 303,000 tons, Japan with 255,000 tons, Holland with 182,000 tons, and four other countries with over 100,000 tons each.

Marine Draftsmen's Convention

The eighth annual convention of the American Society of Marine Draftsmen, will be held at the Hotel Brunswick, Boston, Mass., on June 20 and 21. Arrangements for the convention are in the hands of the Boston branch of the society.

Since this society was organized in Philadelphia, seven years ago, it has enjoyed a rapid and successful growth, and branches of the society are now located at all the prominent shipyards and navy yards throughout the country. With such a strong organization established for professional purposes, it is rather surprising that a part at least of its annual convention is not given over to the discussion of papers on professional subjects. It is true that lectures and discussions on engineering topics have a place in the regular monthly meetings of the branches of the society, and valuable articles on marine engineering and allied subjects are published in the journal of the society, but it would seem that the position of the society would be greatly strengthened if its annual convention were made the occasion for the reading and discussion of professional papers by its members.

More Officers Needed for Merchant Vessels

The supply of first mates and first assistant engineers in the merchant marine is running short, according to reports from the Shipping Board, and attempts are being made to replenish the supply by promoting those in lower grades, who are entitled by experience to an advancement in rating. Second mates and second assistant engineers ambitious for promotion are urged by officials of the Shipping Board Recruiting Service to take an intensive course of study at the free schools for officers maintained by the Board. From two to four weeks in the classroom usually enables a merchant marine officer to qualify for a license in the next grade above. Over nine hundred students are now studying in these schools for their first licenses, and as many more are wanted who are qualified to try for advancement in grade. The schools are located at leading ports on the Atlantic and Pacific coasts, and on the Great Lakes.

LETTERS TO THE EDITOR

Performance of Geared Turbines

After close observation of the performance of the Westinghouse geared turbine installation in the *Agawam* for a period of three months, and covering a total distance of 9,866 miles, the results far exceeded my expectations. Like many other engineers of the old school, I was quite skeptical regarding the performance of geared turbines under adverse conditions, but I have had an opportunity to watch the performance of the entire installation under most trying conditions.

An outstanding factor of the geared drive in this vessel is its tendency to maintain a constant speed when the vessel is pitching badly. When battering through whole gales and mountainous seas, I observed less than 4 percent increase in revolutions with the vessel loaded, and less than 8 percent with the ship in ballast, the engine being governed entirely by the main governor valve, which controlled the speed in such a manner as to prevent any undue stress or laboring in the engine or gears.

The reduction gears had been severely galled previous to my taking charge of the engine department of the vessel, and it became necessary to run the galled gears after minor repairs, in order that the vessel might proceed on her errand of mercy with a cargo of valuable foodstuffs. I felt considerable anxiety regarding the gears and examined them at every opportunity. Each time I found a slight improvement, and after nearly 10,000 miles' service the gears were in first-class condition, considering their condition when starting the voyage, which I think speaks well for the floating I-beam construction.

No difficulty whatever has been experienced with the main engines, except sticking of the maneuvering valves and governors, which, in my opinion, was due entirely to salt and foreign matter carried over from the boilers, which had apparently been operated on salt water and fuel oil previous to my taking charge.

Like every other engine, the Westinghouse installation also has its disadvantages, among them being chiefly the "automatic gland control valve." This valve, although a well-designed mechanical device, is, in my opinion, far too delicate for successful operation under marine conditions.

New York. J. C. Meisler,
Chief Engineer, S. S. *Agawam*.

Sea Captain Suggests Method of Operating Merchant Marine

Senator Ransdell, in his speech before Congress concerning the best way to handle the ships now controlled by the Shipping Board Emergency Fleet Corporation, gives nine different ways in which it is possible to handle these ships. Personally, the fifth proposition is the one I would favor; that is, chartering the ships on a time charter.

There is no question but that the Government is bound at first to suffer severe loss on the original cost of these ships. This is inevitable. If these vessels are, however, chartered on a time charter basis, the Government will receive all that the trade can carry, which is all that we ever can expect American shipping to get; that is to say, they will simply get paid what foreign ships will carry the same freight for. Under this time charter, the Government pays the crews' wages and the stores.

The writer believes that if this plan were carefully worked out on some such basis as the following, we would,

in a very short space of time, have an efficient naval reserve for our fleet and also a more satisfied lot of seamen, for they would be under better discipline, better fed, and better cared for than the ordinary seamen:

1. The Government should see to it that these ships are manned absolutely by naval reserve men.

2. That these men are engaged on such terms as now hold in the Navy; that is, during their term of engagement they can be transferred from one ship to another.

3. That it be arranged that these men spend part of the year on a merchant vessel and part of the year on a man-of-war, or training ship.

Prior to the war, the chief officer of a tramp steamer in England never got leave. He would be out four to six months on a voyage, and when the vessel arrived in an English port his wife would probably go down and spend a week with him in that port. Such a thing as getting to his own home was out of the question.

If our vessels were manned by naval crews, the question of leave after a voyage, by simply transferring from one boat to another, could be arranged very easily; for the simple reason, that all of the crews would be under one management—the Government—instead of, as in England, the crews all being on separate ships with separate owners, and no one with whom to relieve the crews.

This is one of the causes for the tremendous "float" among seamen of the merchant marine. For instance, an officer on a tramp steamer getting no holidays, voyage after voyage, becomes dissatisfied and leaves his vessel so that he may have a few weeks at home. This immediately turns him into a "floater," because his next position as chief officer is with a new company and this practically kills his chance for a promotion. In fact, his only chance for promotion now is everlastingly to stick on the job and ignore the home life.

The greatest hardships of the old-time shipping were the food, quarters, lack of shore leave, and the general life of the seamen. If our merchant marine is handled absolutely by reserve men, or by naval men assigned to merchant ships, the life ought to prove very attractive to a great many young men. I believe, with Senator Ransdell, that the way these men are treated in the future will help to make life at sea attractive to them. The comfort of the *personnel* on the merchant vessel will have more to do with building up and holding the vessels we now have than any other feature. CAPTAIN.

Future of the American Merchant Marine from Standpoint of Steamship Operator

BY O. C. CHAPMAN

The two major industries concerned with the future of the American merchant marine are shipping and shipbuilding. Hitherto most of the opinions published in these columns regarding methods of upbuilding the merchant marine have emanated from the ranks of the shipbuilders. In this article the problem is discussed from the standpoint of a practical steamship operator who has had extensive experience in both shipbuilding and ship operation. From this point of view the standard by which ideas and opinions are judged are their practicability, and the author makes a strong appeal for giving practical men full control and authority in establishing the merchant marine. Some of the most serious handicaps which must be contended with are the high wages paid for labor in both the building and operation of ships and the impractical provisions of the Seamen's Act, which must be revised. Obviously, such matters cannot wait, and shipowners must realize that now is the time not only to plan but to act.—THE EDITOR.

OUR country has always been full of optimists, which, in a way, accounts for the great results we have obtained in many of our industries and in our business conditions in general; but the greatest optimism in the world cannot overcome or remove impossibilities. With all due respect to the accomplishment as well as the flowery prophesied future of our American shipping business, a little constructive criticism may, in a way, help some of our very enthusiastic rooters to see that it is quite impossible to lift a platform while standing upon it. In other words, as far as our shipping prospects are concerned, there have stood for some time, and still stand to-day, barriers which practical men know cannot, without some revamping, be overcome. Experienced men are witnesses to the fact that when expenses are greater than the income there is no incentive for private enterprise.

Our laws and the labor conditions of the country determine the costs, while the revenue or income is what is secured by the transportation back and forth across the oceans, at a fair profit, of the merchandise of any nation. Our enthusiastic rooters and our prophets who are telling us of the grand, glowing future for our merchant marine without a change in laws, more economic conditions or a change in the attitude of labor, are inexperienced, impractical men, who have never seen their hard-earned dollars go down in competition with foreign shipping.

WHY THE OCEAN LINERS FLY FOREIGN FLAGS

Have you ever watched a magnificent steamer sailing down New York Bay with a foreign flag at her stern and wondered why an American flag was not there in the place of the foreign flag? Did you not notice in the appearance of that ship an atmosphere of prosperity and grandeur which made you wonder still more why it was a foreign ship instead of an American? There is a long story attached to this, but the real reason is that if that vessel were carrying an American flag, more good American dollars would have to go out in expense than could be returned in income. There would be loss instead of a profit at the end of each voyage, or, in other words, there is no money in it!

In getting at results the following conditions are in their own way the reasons why the outgo is greater than the income: Higher cost of construction; higher costs of

operation; impractical and unprotecting laws; lack of government support; prejudice against shipowners by inland inhabitants; foreign interest in American railways and industries; lack of universal political interest in matters of the sea; political influence preponderating toward inland interest and several similar causes.

Our inexperienced superiors are declaring in strong terms all over the country (with the idea of getting the support of the sentimentally patriotic people, who, of course, mean well) that American talent and ability will overcome all difficulties. But this has not been borne out in practice—man for man, condition for condition, yes, but with all the above-enumerated conditions against him, no! The present condition of our merchant marine substantiates that these things cannot be overcome. Our present merchant marine may seem fine from a description or report of the Shipping Board, but the United States Treasury is behind that and we do not hear much of profits at any angle.

Government-Owned Merchant Marine Impractical

A government-owned merchant marine will not, in anything like the same degree, build up our country as will a privately-owned merchant marine. In the first place, government-constructed ships in peace time require twice the length of time to build, about one-half as much more money and the result is not so satisfactory, as, when occasion arises for changes in the construction work, no one seems to have any authority or is able to act quickly in any matter, no matter how important. Privately owned steamers can be built for less money, more quickly, and more efficiently, to suit the trade than can any government ships. Why cannot the same be applied to the operations? If this is true, a private line of steamers could surely more efficiently compete with outside ships than Government-owned steamers.

We come to the application of the privately owned fleet to its work. In the first place we must look not at the present but some six or seven years hence, when ample tonnage of all nations to handle the vast shipping of the world has been constructed and rates are back to normal. Up to the present, from the best information I can get, not a single steamship organization operating in transatlantic or Pacific trade under the American flag has ever been a paying proposition. It may be that the Atlantic Transport Line, which was capably managed, made a profit, but at present I am unable to say. We have already noted the conditions which bring this state of affairs into effect. If there is a way to overcome them, why not find out our trouble and attempt to remedy it?

High Cost of Construction and Operation of Vessels

The cost of construction of vessels here has gone to $200 (41/13/4) per deadweight ton. Wages have been increased and labor has been granted its every whim in the ship line by the government. Costs of construction and repairs have gone to unheard-of proportions and relief is not in sight, for labor seems to have the whip hand, especially in the line of work controlled by the government.

If no way is found to overcome the excessive costs necessary to operate our merchant marine at a profit, it is hardly worth while to spend so much money on ships for foreign business. Government interference in private industry is always expensive and increases costs, so that it will shorten our troubles to get down to practical methods with practical business men and determine if it is possible to operate American ships in foreign trade profitably.

Can American Ships Be Operated in Foreign Trade Profitably?

While it is true that foreign owners are trying to place orders for ships in American shipyards, even at the present high rates of construction costs, nevertheless it must be remembered that the foreign shipowners are very shrewd business men, and that just now the shipping rates will pay for the present high rates. The foreign owner, however, has two other points in view; one is that he cannot get ships abroad and he must have ships to keep his business going even if a loss is sustained. This will in a way prevent competition, and also the foreign ships which have to date been contracted for in American yards have been sold to American owners or others at greatly increased prices.

In trying to outline a plan for the success of the steamship business, we must for the moment lose track of the builder, for without the operator the builder will have nothing to do, and it is very evident that some of the ideals which now stand in the way will have to be removed. Labor conditions must come secondary to these things and rates must be brought to requisite levels. Patriotism will not support a family unless it is subsidized, and for the present we are trying to keep away from subsidy, although assistance along this line would cover a multitude of sins.

Dreams Will Not Support an Overseas Merchant Marine

Mr. Hurley asks us to give our undivided support to the merchant marine, and assures us that the merchant marine will take on a new era. He also asks us to study foreign countries and for the American youth to dream dreams of foreign countries and to cultivate the natural law of the sea. This is a fine idea, but, without all these things, we already know that with the present conditions it will require more than dreams and undivided support to put the overseas merchant marine of the United States on a paying basis. Is it better to pay wages and other expenses which are undue and exceptionally high and then ask the general taxpayer to pay into the government the cash necessary to pay out again to government employees, or even in subsidy (which may at any moment be cut down or done away with by political bosses), to make a profit on the operation of ships for either private or government-owned ships? Or is it better first to get costs and expenses down where they should be?

The Seamen's Act a Handicap

Regarding the high cost of operation under the American flag, we are handicapped by the LaFollette law, which was put into operation by inexperienced and impractical men and which sickens and humiliates an operator or owner. No explanation of this is necessary to the practical man. Such laws should be framed and exacted by men of experience who are practical. The sailor signs a contract, but he has no idea of keeping it if he can do better by breaking it. He can break any agreement—and that is all there is to it—but the owner has to live up to his contract or suffer severe penalties. A sailor can hold up your ship, demand his money, take French leave, stop work if the cook does not suit him, charge overtime for anything he may do after schedule time, get drunk and cuss the officers and the law upholds him, or, in fact, makes it impossible to overcome these things without great delay, considerable expense and disheartening humiliation.

America, it seems, will emerge in a few years with about fourteen million deadweight tons of merchant ship-

ping. The majority of the steel ships are supposed to be suitable for any service. The fabricated ship has as yet had no test upon its endurance qualities, but they are seaworthy, good bulky cargo carriers, and we are advised that they can be built considerably cheaper than the usual type of ship heretofore built. However that may be when many ships are being built, private owners do not order ships by the hundred. Usually the contract is for one or two ships. For my own use I would prefer the ship built in the old-fashioned way, which has always been reliable. However, it will no doubt be possible to get good service from all the steel ships we can get hold of for the next few years, but they cannot at present be operated at a profit under the American flag. If Shipping Board vessels could be sold to private owners at around $125 (26/0/10) a deadweight ton for the steel steamers, it would go a long way toward putting an American merchant marine on its feet.

Higher Wages Should Bring Better Service

In the operation of vessels, which will very soon be a very important American business, it may be possible to pay American seamen higher wages and compete successfully with foreign ships, but in doing so we must receive in return better results, better service, more efficiency per man. Are we doing this? Will we do this? When foreign shippers pay 50 cents (2/1) for a certain service, we cannot compete and pay $1 (4/2) for the same service. This means that our seamen and mechanics must for the increased rate give increased service. If they do not, we cannot operate vessels on the sea profitably in competition with foreign nations and pay any higher rates for first costs or for operating charges and wages. All who have to do with the construction and maintenance of ships well know this.

American Classification and Insurance Necessary

It is very necessary that American classification of American ships be effected. It is evident that owners would be benefited in more ways than one if they would arrange a mutual working agreement between themselves and our American Bureau of Shipping, which is fully competent to handle this work. This should be carried out with a view to enabling the owner to understand the importance of the classification bureau and the importance of having such matters fully American and co-operative.

The next in importance is the marine insurance, and there is no reason why all these policies should not be underwritten here, which in its turn will make more independent American operation, give better satisfaction, and with competent management will be more economical. Our shipowners, the classification bureau and the insurance people could by proper co-operation get a practical insurance system which would benefit the owners, the bankers and the general public. The classification and the insurance interests have no defective laws to hamper them or to prevent perfect conditions from being obtained along this line; and there is absolutely no reason why it should not be done, as our resources and capacity are fully equal to the occasion.

Now is the time for our shippers, vessels owners, shipbuilders and insurance men to work together to promote these essential branches on a practical basis. It can be done; there is no law handicapping this part of the programme, and there is money in it. We need practical men in every branch of the undertaking, and perfect results cannot be obtained unless practical men are given full control and all authority. We are then sure of the results and will not awake later to realize that we are on the wrong track.

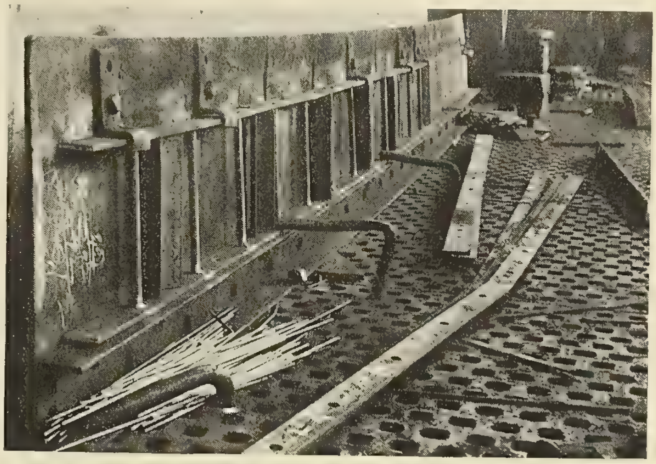
We are watching the building of our merchant marine; we are hoping that the very best results will be obtained. We expect to see the country from the Atlantic to the Pacific and from Canada to Mexico benefited by these things. Who will get a co-operative organization together and start the ball rolling and be satisfied to stomach the criticism that is bound to come? We all await further and better suggestions along these lines, and live in hopes that some attempts will be quickly made, not only to suggest but to act.

Handy Clamping Device Used in Manufacturing Ship Ladders

BY CHARLES C. PHELPS*

It is common practice to weld the rungs to the sides of ship ladders by means of the oxy-acetylene blow pipe, resulting in exceptional rigidity of the structure. A convenient device for clamping the ladder while welding is in use at the shop of the Bethlehem Shipbuilding Corporation at Sparrow's Point, Md. The device consists of two channel bars between which is riveted a heavy steel plate, the latter in a vertical position.

One side bar of the ladder to be made is placed on the upper flange of one of the channels and held in position



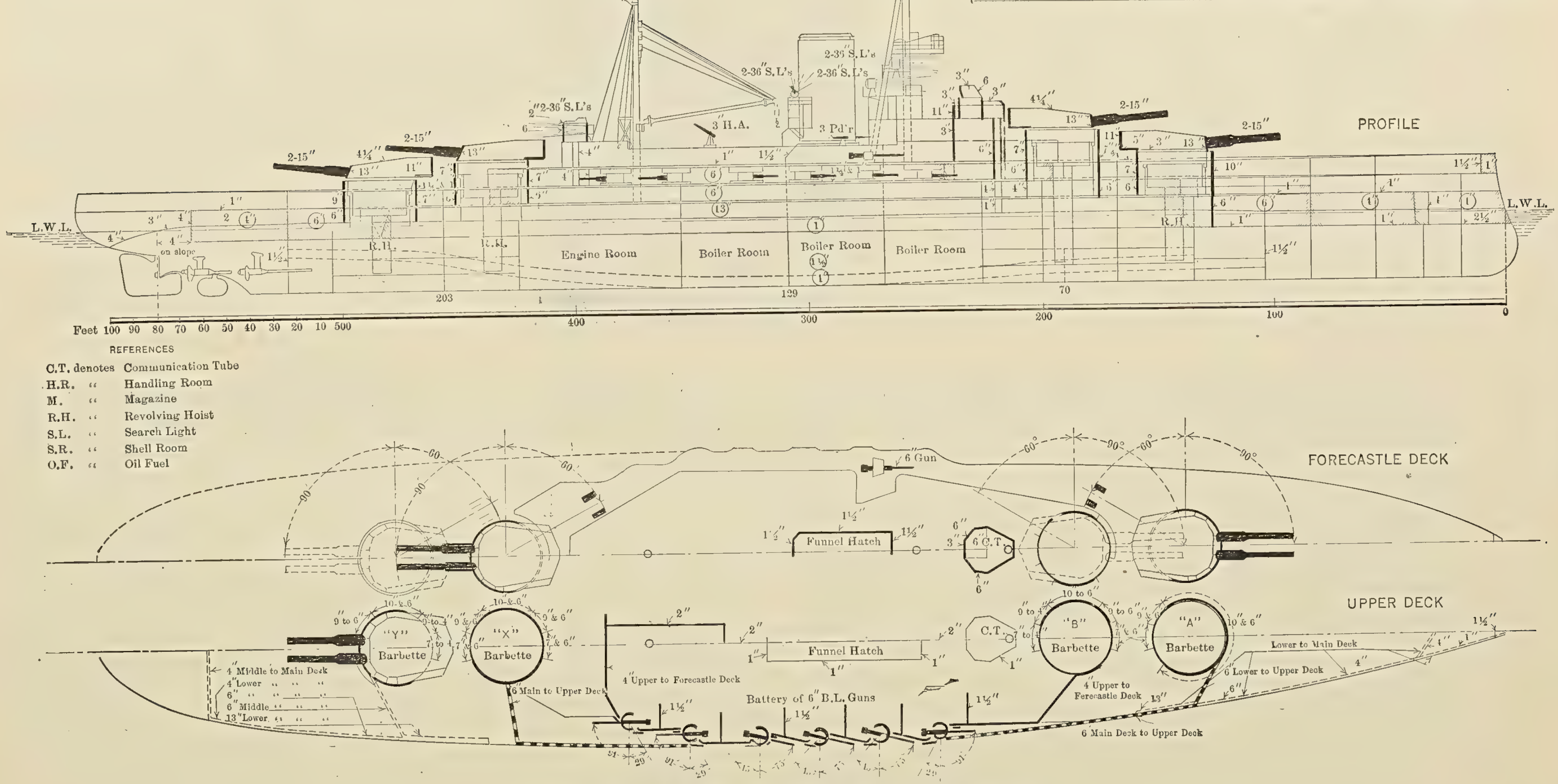
Device for Holding Ladders While Welding Rungs with the Oxy-Acetylene Blowpipe

by means of dogs connecting with the bending floor. Vertical slots cut in the upper part of the vertical plate accommodate bolts which pass through the plate and secure several small clamps. These clamps hold the other side of the ladder in position and, by being adjustable, they can clamp ladders of various widths. Angle iron "clips," placed between the sides of the ladder, keep the ladder's width uniform throughout. The rungs are then dropped into position through the holes punched in the ladder side bars.

In welding with the oxy-acetylene blow pipe, first the tops of the rungs are welded to the outside of the upper side bar and the inside of the lower side bar is welded to the lower parts of the rungs, after which the ladder is unclamped and inverted so that the corresponding places on opposite sides of the ladder may be welded. Steel filling rod is used while welding, thereby insuring ample metal at the joints and a smooth finish.

* With Oxweld Acetylene Company, New York.

	Where Built	Commenced	Launched	Completed
Royal Sovereign..	Portsmouth	Jan., 1914	April, 1915	May, 1916
Royal Oak.......	Devonport	Jan., 1914	Nov., 1914	May, 1916
Revenge	Vickers	Dec., 1913	May, 1915	March, 1916
Resolution	Palmers	March, 1914	Jan., 1915	Dec., 1916
Ramillies	Beardmore	Nov., 1913	Sept., 1916	Oct., 1917



REFERENCES

C.T. denotes Communication Tube
H.R. " Handling Room
M. " Magazine
R.H. " Revolving Hoist
S.L. " Search Light
S.R. " Shell Room
O.F. " Oil Fuel

Fig. 1.—H. H. S. *Royal Sovereign* of the 1913-1914 Programme

Naval Construction During the War*

Main Particulars of Naval Vessels Built for Great Britian From 1914 to 1918—Vessels Taken Over From Foreign Governments

BY SIR EUSTACE TENNYSON D'EYNCOURT, K.C.B.

IMMEDIATELY after war was declared, great pressure was exercised to complete the ship then building for the navy, and to order such other vessels as could be designed and finished in the shortest possible time. Generally speaking, therefore, the construction of new battleships was ruled out. With the acquisition of the *Agincourt*, *Erin* and *Canada*, which were building here for foreign governments in private yards, and bearing in mind the early completion of the remaining two vessels of the *Iron Duke* class, shortly to be followed by the vessels of the *Queen Elizabeth* class, we had a great preponderance of heavier capital ships, or *Dreadnoughts*, over the enemy; and as this class of ship takes longer to design and construct than any other, it was obviously a prudent course to concentrate on such types as were specially needed and could be built more quickly.

It should also be remembered that the menace of the submarine, which was from the first beginning to loom as a vital factor in the war, pointed in the direction of large numbers of patrol boats, torpedo-boat destroyers and smaller types of vessels to deal with this menace. No time, therefore, was lost in placing orders for additional destroyers, submarines, light cruisers, sloops, mine-sweepers, patrol boats, etc.; and it very soon became clear that the dockyards and the regular warship-building contractors would not be able to cope with the mass of new construction that was required.

Naval Vessels Built by Merchant Shipbuilders

Accordingly, orders for many of the last-named classes were placed with builders who had hitherto only been accustomed to mercantile work. With the arrangements that were made, however, for superintending and overseeing the work by the Admiralty, with the assistance of the registration societies—Lloyd's and the British Corporation—very little difficulty was experienced in getting the work satisfactorily carried out by the firms new to this class of shipbuilding, and I think the results show what success attended the arrangements made.

To take ships added to the navy during the war in the proper order, it is necessary to begin with battleships of the *Iron Duke* class. The particulars of all previous *Dreadnoughts* are pretty well known and have been published. The *Iron Duke* class, of which there were four, followed the *King George V* class both in sequence of time and in general characteristics. The same main armament, similarly arranged, with the five turrets all on the centerline of the ship, was adhered to, the chief difference in the *Iron Dukes* being that, instead of the 4-inch guns forming the secondary armament, a battery of twelve 6-inch guns protected by 6-inch armor was, after considerable discussion, finally decided upon. The protection also was somewhat increased over that of the *King George V*, involving an increase in dimensions over any of our previous battleships, due to the addition of these weights and of other items. Two of the class had been laid down in January, 1912, and two in May, the four vessels being completed in March, June, October and November, 1914, so that two were ready just before, and two shortly after, the declaration of war. Four torpedo tubes were carried in lieu of three in the previous ships, and after the battle of Jutland a considerable amount of additional protection was added over the magazines, a course which was practically adopted in all our ships at that time as a precautionary measure. Only in one case was any portion of a shell found to have penetrated below the protective deck; but with the ever-increasing range at which actions have been fought, and the increasing penetration of improved shell, the danger of the decks being inadequate had to be considered.

The tables appended give the general particulars of these ships and of all the others with which I am dealing in this paper. It should be mentioned, however, that the speed obtained on trial was approximately 22 knots, or about a knot in excess of the legend speed.

The "Iron Duke" Class

Special interest is attached to this class, as the *Iron Duke* was the fleet flagship during the whole time of Admiral Jellicoe's appointment as commander-in-chief, and she was in action at Jutland with her sister ships. The *Marlborough*, it should be specially noted, was the only British battleship of the post-*Dreadnought* type struck by a torpedo during the whole war, and the value of the longitudinal protective bulkhead and of the subdivision and arrangements adopted was clearly shown, as the ship was able to remain in the line, no vital damage being done. She was afterwards safely docked in the Tyne and repaired. This is, I think, specially interesting, as many of our older ships, some with centerline bulkheads and with other arrangements not so good for dealing with underwater damage, were sunk in the Dardanelles and elsewhere by enemy torpedoes.

1912-13 Programme

The next type to note is the *Queen Elizabeth* class of 1912-13 programme. Three of these vessels, after taking a little more than two years to build, were completed in January, March and October, 1915. The other two were completed in February, 1916. A very considerable departure was made in the *Queen Elizabeths* from any previous *Dreadnoughts*, the 15-inch gun taking the place of the 13.5-inch, and the designed speed being increased by 4 knots over our previous *Dreadnoughts*, while the secondary armament was similar to that of the *Iron Dukes*, consisting of 6-inch guns. Their very great increase of speed involved practically doubling the horsepower necessary to give the 25 knots desired, and the great increase in the weight of the 15-inch guns and mountings over the 13.5-inch meant accepting only four turrets with eight 15-inch guns, as against five turrets with ten 13.5-inch guns in our previous ships, and even so the armament was considerably heavier. The further great departure from previous practice in battleships was the adoption of oil only as the fuel. This necessitated special arrangements of the oil bunkers, many of which were 30 feet in height, and required special construction to withstand the head of oil. The armor and protection were fully maintained as compared with previous ships, but all these additions involved increasing the displacement to 27,500 tons.

In the battle of Jutland, the fifth battle squadron,

* From a paper read before the Institution of Naval Architects, London, April 9.

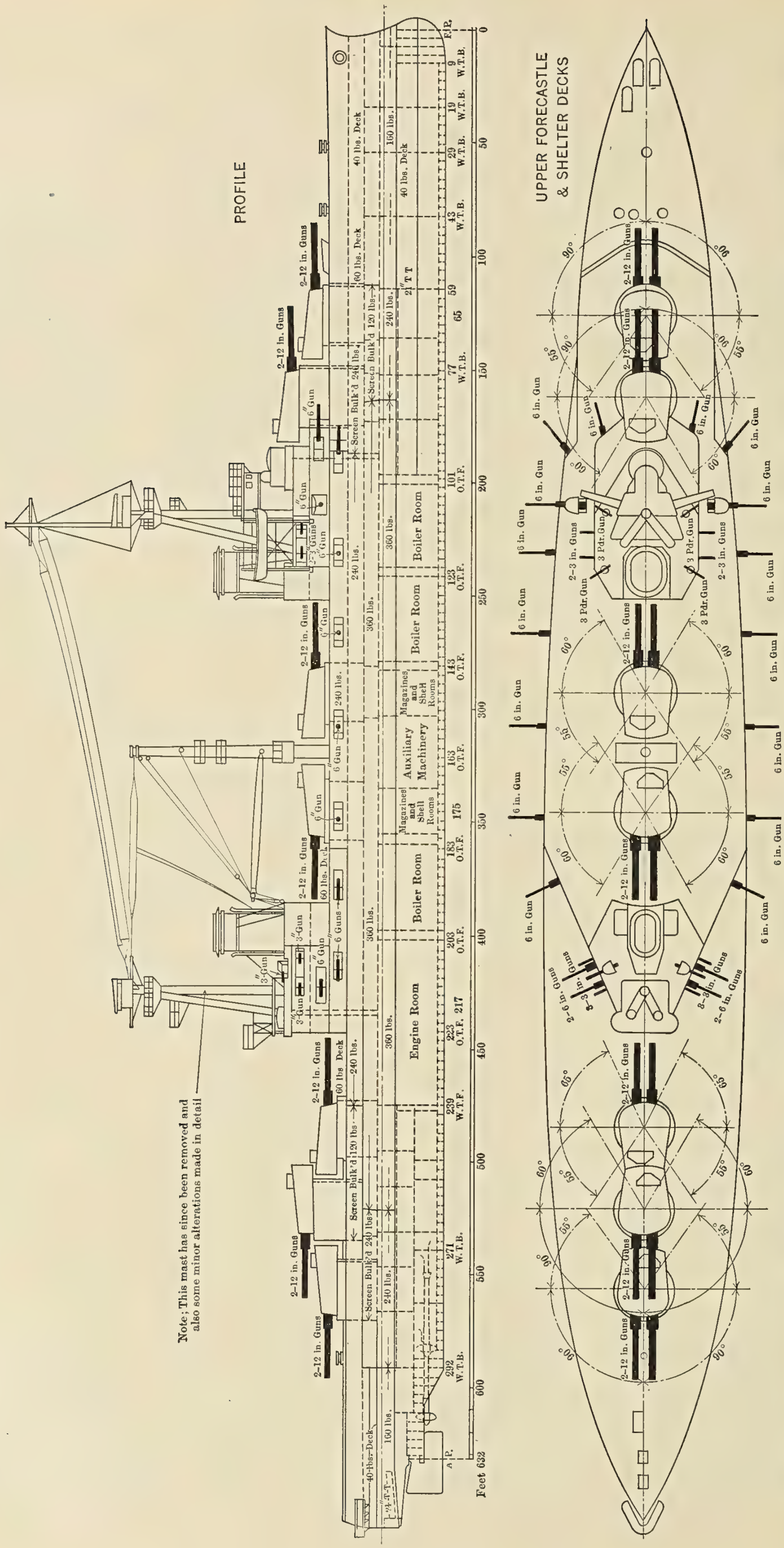


Fig. 2.—H. M. S. *Agincourt*, Originally Designed for the Brazilian Government, Transferred to the Turkish Government in 1914 and Taken Over by Great Britain at the Beginning of the War

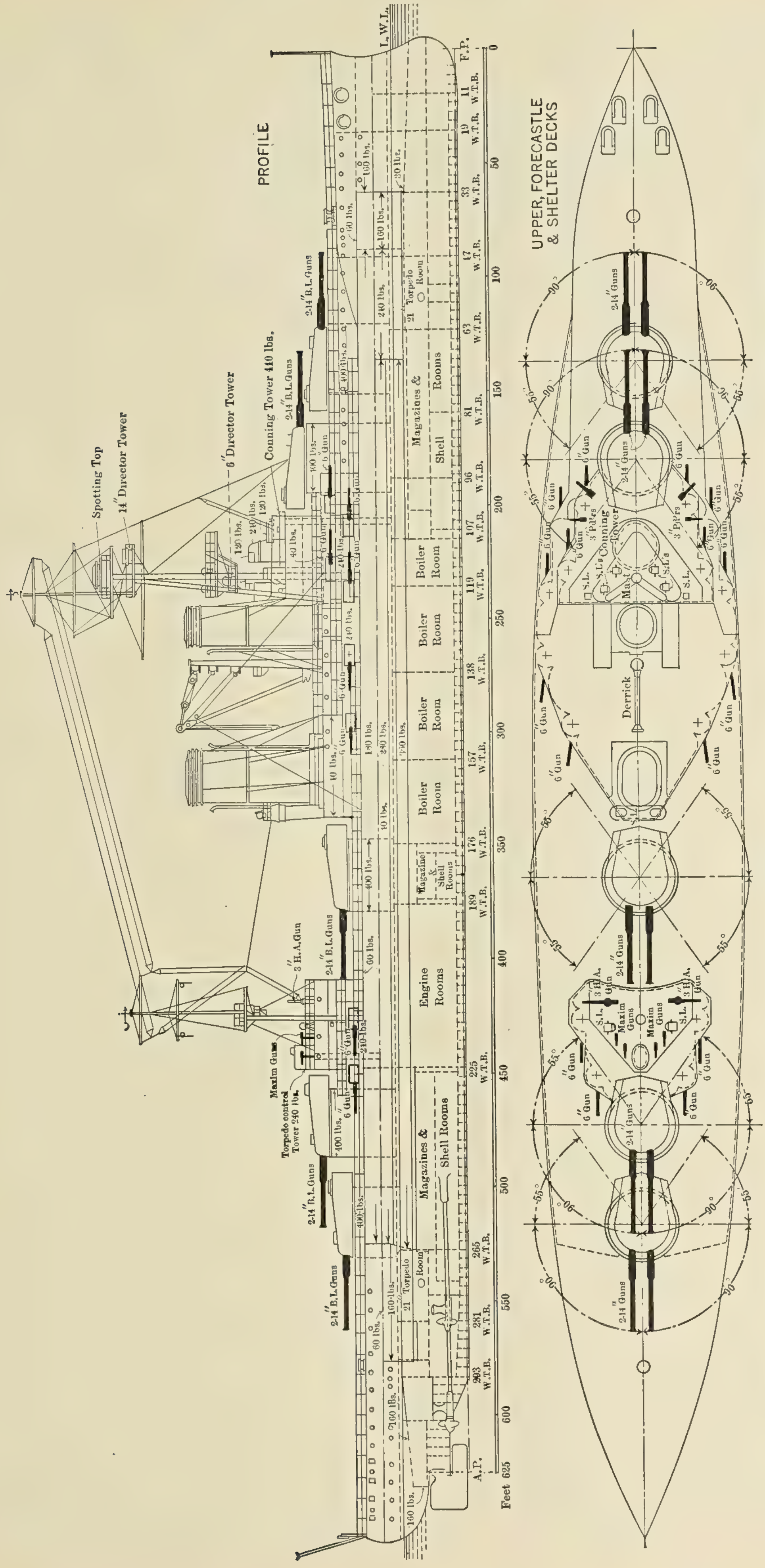


Fig. 3.—H. M. S. *Canada*, One of Two Sister Ships Laid Down in 1911 at Elswick for the Chilean Government, But Taken Over by the British Government During the War

consisting of four vessels of this class were heavily engaged for several hours, and although they inflicted and sustained heavy punishment, especially in the case of *Warspite,* all the vessels gave a splendid account of themselves and were not seriously damaged or put out of action. After the battle of Jutland, additional protection was added to the magazines. It may be mentioned that the oil fuel proved a complete success, it being found easier to keep up a high sustained speed, and a smaller complement also is, of course, involved, as there is great saving in personnel as against that required for a coal ship.

I should mention that Sir Philip Watts was responsible for the design of the *Iron Duke* and *Queen Elizabeth* classes, thus completing a series of twenty-seven battleships of the *Dreadnought* class designed and built during his tenure of office at the Admiralty, in addition to the large number of battle cruisers and light cruisers and other vessels built during that period—truly a great record.

Battleships of the "Royal Sovereign" Class

The next in order came the *Royal Sovereign* class of the 1913-14 programme. These vessels were to have the same armament as the *Queen Elizabeth,* but, as there was some question about the supply of oil fuel when the design was discussed, it was decided to revert to coal, and also to accept the slower speed of 21 knots, which would make them more homogeneous with other *Dreadnoughts.* Subsequently, when the vessels were in process of construction and the great advantages of the use of oil fuel with other types of warships became apparent, it was decided to change from coal to oil, and it was anticipated that increased power giving a speed of about 23 knots would be obtained. As a matter of fact, when fully laden with about 4,000 tons of oil, the *Revenge* attained 22 knots, which was equal to about 23 knots in the designed load condition. A different disposition of deck and side armor was also adopted by which the thick protective deck at the center of the ship was brought up to the level of the main deck, this portion of the protective deck being well above the level of the deep load line, and giving more protected freeboard in the damaged condition than in any of our earlier battleships. This was an important feature, as a somewhat reduced metacentric height was decided upon for these ships with a view to making them steadier gun platforms than some of the ships with larger G. M. The vessel was provided with good underwater protection, which in certain of the ships was further reinforced by adding outside bulge protection. This was done to *Ramillies* before her launch and also to two other vessels of the class after they had been in commission some time, during refit, and it is proposed to add the bulge to the remaining two ships of the class when opportunity offers.

The addition of bulges was suggested by myself originally for the *Edgar* class, for which I designed this form of protection in 1914, after considerable experiments had been made. The results have proved the efficiency of the bulges.

Battleships Taken Over from Foreign Governments

The three ships taken over from foreign governments were of different types, as shown in the table of particulars.

H. M. S. *Agincourt* was commenced in September, 1911, for the Brazilian Government, when I took out various designs (got out under Mr. Perrett at Elswick) to Rio de Janeiro and finally settled on the design of the *Agincourt,* after modifying it very considerably on the spot. The Brazilian authorities, after much discussion, decided upon fourteen 12-inch guns, twin-mounted in seven turrets. This involved a ship with a length of 630 feet between perpendiculars and 670 feet over all. The main armor was somewhat lighter than our British *Dreadnoughts* (as seen from the particulars attached), and in other respects, such as fueling facilities, the ship hardly came up to the British standard. However, she was well reported on and the fourteen big guns were liked by the gunnery officers, who preferred a large number of guns for their salvoes. Certain alterations had to be made to fit her for our service, but in the main she was left as designed.

I should perhaps mention that in 1914 she was transferred from the Brazilian Government to the Turkish Government, and when war broke out she was on the point of leaving for Constantinople, when she was taken over.

The design of the *Erin* was settled by the three firms, Armstrongs, Vickers and John Brown, in consultation with the Turkish authorities, for whom the vessel was built, being commenced in November, 1911. In general characteristics she more nearly followed the *King George V* class than any other British ship, except that the secondary armament consisted of 6-inch guns, as in the *Iron Duke* class. This vessel also was taken over by the British Government in August, 1914, and certain modifications made to fit her for the British service. In respect of quantity of fuel carried, the *Erin* was below the standard adopted for vessels designed for the British navy.

The third ship taken over from a foreign government was ordered and commenced in 1911 at Elswick from designs prepared by Mr. Perrett for the Chilean Government. There were two ships of the class, the *Almirante Latorre* (now the *Canada*) and the sister ship the *Almirante Cochrane* (now the *Eagle*). The *Canada* has ten 14-inch guns, twin-mounted, in the centerline, and was originally designed to have twenty-two 4.7-inch as the secondary battery, but this was subsequently altered to sixteen 6-inch guns. The protection again was somewhat lighter than that of our own *Dreadnoughts,* but the speed was rather higher, viz., 22¾ knots, and as a matter of fact this speed was considerably exceeded on trial. The ship was taken over by the British Admiralty in September, 1914, and completed, after certain necessary modifications, a year later. Her fuel consisted of coal, with the addition of a certain amount of oil, as in most of our battleships.

The sister ship, *Almirante Cochrane,* remained in an uncompleted condition on the stocks at Elswick till the spring of 1917, when she was taken over by the British Government and rearranged as an aircraft-carrying ship. She was renamed H. M. S. *Eagle,* and, as a compliment to the United States Navy, she was, at the request of the Admiralty, launched by Mrs. Page, the wife of the late American Ambassador.

The above record finishes the list of battleships proper which were completed for service during the war.

Large Battle-Cruisers

Coming to the battle-cruisers, particulars have already been published of all these down to H. M. S. *Tiger.* This ship was included in the 1911-12 programme and followed on the *Queen Mary,* the general features of the two ships being much alike, the chief differences being that the secondary armament of *Tiger* is twelve 6-inch guns in lieu of sixteen 4-inch in *Queen Mary,* and *Tiger* has two submerged torpedo rooms, whereas *Queen Mary* had only one.

After the design was approved by the Board, the ship was ordered and laid down at Clydebank on June 12, 1912, and completed in October, 1914. In common with so many of our ships completed during the war, the early commissioning and joining of the fleet was so imperative that

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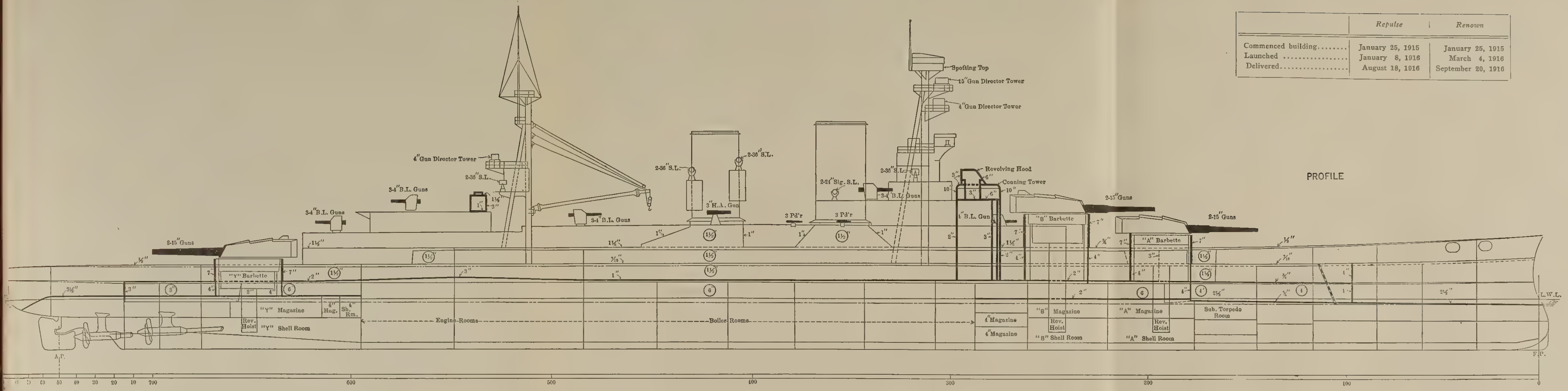
BRITISH NAVAL CONSTRUCTION DURING THE WAR

From a Paper Read by Sir Eustace Tennyson d'Eyncourt, K. C. B., Before the Institution of Naval Architects

	Repulse	*Renown*
Commenced building	January 25, 1915	January 25, 1915
Launched	January 8, 1916	March 4, 1916
Delivered	August 18, 1916	September 20, 1916



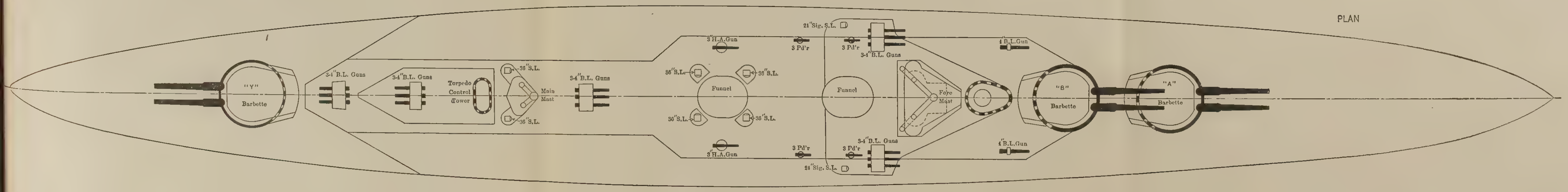


Fig. 4.—Battle Cruisers *Repulse* and *Renown*

BRITISH NAVAL CONSTRUCTION DURING THE WAR

From a Paper Read by Sir Eustace Tennyson d'Eyncourt, K. C. B., Before the Institution of Naval Architects

	Courageous	*Glorious*
Commenced building........	March, 1915	May, 1915
Launched	February, 1916	April, 1916
Completed	November, 1916	November, 1916

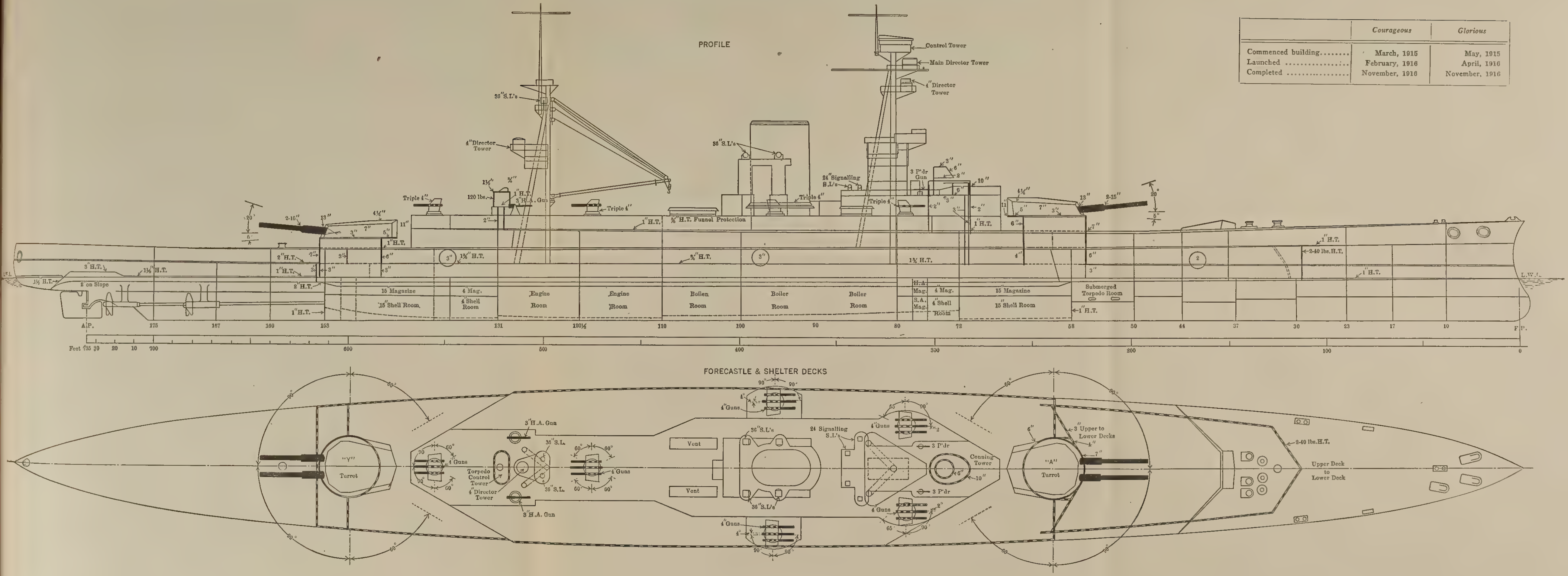


Fig. 5.—Battle Cruisers *Courageous* and *Glorious*

no exhaustive trials in deep water were carried out, but the runs made on the Polperro Course showed that the designed power of 108,000 shaft horsepower could be obtained with little difficulty, corresponding to a speed of 30 knots. During the progress of the design, the oil fuel capacity was very largely increased in case of need; the

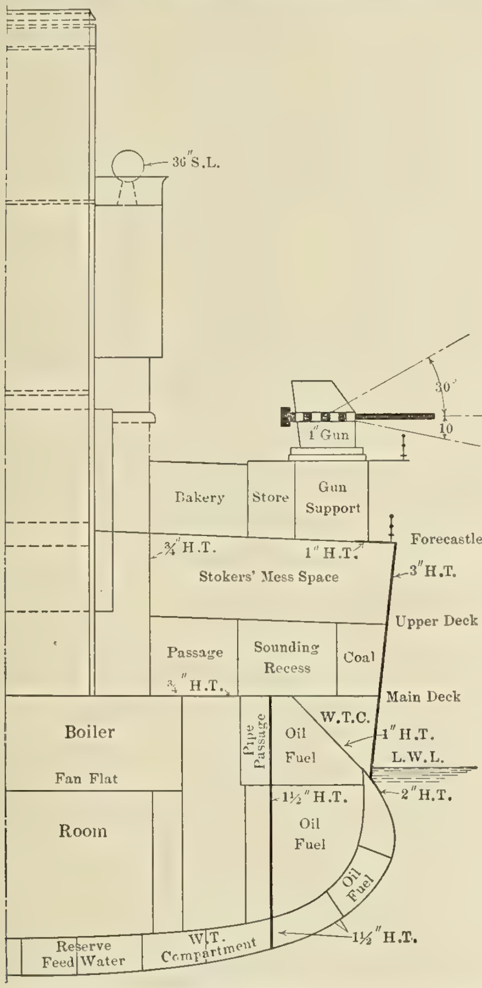


Fig. 6.—Section Through Boiler Room, H. M. S. *Courageous*

original tanks, which only allowed for 1,100 tons, were supplemented to admit a maximum oil stowage of 3,480 tons, in addition to the 3,320 tons of coal; but it is not usual for the vessel to carry this full fuel stowage—at any rate, of oil.

Battle-Cruisers "Renown" and "Repulse"

At the commencement of the war, two additional battleships of slightly modified *Royal Sovereign* type, viz., the *Renown* and *Repulse*, had been laid down, but in view of the long time it would take to complete these ships the construction was not pressed forward. Immediately after the battle of the Falkland Islands, in which our battle-cruisers *Invincible* and *Inflexible*, in company with other smaller cruisers, annihilated Von Spee's fleet, the value of the battle-cruiser type became very apparent, and on the initiative of Lord Fisher, then First Sea Lord, it was decided to stop the construction of *Renown* and *Repulse* as battleships and to alter the design completely into that of very fast battle-cruisers.

I received instructions to re-design these ships about Christmas, 1914. The new design had to give a speed of 32 knots, with the largest number of guns possible for such a vessel, and with protection similar to the *Invincible* and *Indefatigable* classes. A modified form of bulge was adopted in these ships to give additional underwater protection against torpedo attack. Proposals are now under way for still further adding to this bulge protection.

The general outline design was completed and approved in ten days, and six 15-inch guns adopted as the main armament, the secondary armament consisting of seventeen 4-inch guns, of which fifteen were mounted in five specially designed triple-gun mountings. Owing to the circumstances referred to above, it was necessary that the ships should be completed at the earliest possible date, and I suggested that *Tiger's* machinery should be repeated with some additional boilers, and with the extra length it was found possible to obtain the speed of 32 knots, as laid down by the Board. Lord Fisher also insisted that the ships must be completed within fifteen months—an abnormally short time for an entirely new design, without

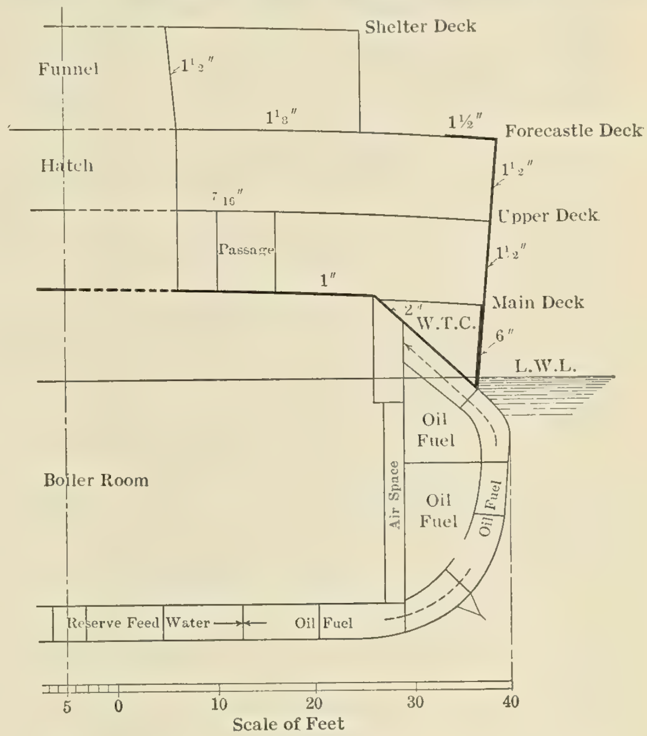


Fig. 7.—Section Through Boiler Room, H. M. S. *Repulse*

any drawings prepared. This period of completion was not realized, although not greatly exceeded.

By January 21, 1915, the two firms entrusted with the orders, viz., Messrs. John Brown and Fairfield, were supplied with sufficient information to enable them to proceed with the structure, and both keels were laid on January 25. All the drawings and specifications were completed by April and the design finally approved in that month. The fuel was to be entirely oil, and with the additional boilers the power expected to be from 110,000 to 120,000 shaft horsepower, the latter having actually been obtained on trial.

Repulse was launched in January, 1916, less than a year from the laying down, and the *Renown* was launched three months later. *Repulse* went through her commissioning trials early in August, and *Renown* followed one month later and was completed in September.

The speed of *Repulse* on trial was over 31¼ knots in the deep condition, and the *Renown* obtained 32.6 knots mean speed on the new measured course off Arran in the normal condition.

The ships have been well reported upon at sea and maintain their speed well.

I think that the construction of these vessels in a little over one and a half years from the first order to get out

TABLE I.—DIMENSIONS OF TYPES OF BRITISH WARSHIPS BUILT DURING THE WAR

	Battleships						Battle Cruisers		Large Light Cruisers	
	Iron Duke	*Queen Elizabeth*	*Royal Sovereign*	*Agincourt*	*Erin*	*Canada*	*Tiger*	*Renown*	*Courageous*	*Furious*
Length between perpendiculars	580 ft. 0 in.	600 ft. 0 in.	580 ft. 0 in.	632 ft. 0 in.	525 ft. 0 in.	625 ft. 0 in.	660 ft. 0 in.	750 ft. 0 in.	735 ft. 0 in.	750 ft. 0 in.
Length overall	622 ft. 9 in.	643 ft. 9 in.	624 ft. 3 in.	671 ft. 6 in.	559 ft. 6 in.	661 ft. 0 in.	704 ft. 0 in.	794 ft. 0 in.	786 ft. 3 in.	786 ft. 6 in.
Breadth, extreme	90 ft. 0 in.	90 ft. 6 in.	88 ft. 6 in.	89 ft. 0 in.	91 ft. 7 in.	92 ft. 0 in.	90 ft. 6 in.	90 ft. 0 in.	81 ft. 0 in.	88 ft. 0 in.
Load draft, mean	28 ft. 0 in.	28 ft. 9 in.	28 ft. 6 in.	27 ft. 0 in.	28 ft. 6 in.	28 ft. 6 in.	28 ft. 6 in.	25 ft. 6 in.	22 ft. 3 in.	21 ft. 6 in.
Displacement in tons	25,000	27,500	25,750	27,500	23,000	28,000	28,500	26,500	18,600	19,100
Shaft horsepower of engines	29,000	75,000	40,000	34,000	26,500	37,000	108,000	112,000	90,000	90,000
Speed at load draft (knots)	21	25	23	22	21	22¾	30	32 nearly	32	31½
Fuel at load draft (tons)	900	650	900	1,500	900	1,150	900	1,000	750	750
Coal capacity (tons)	3,250	......	......	3,200	2,120	3,300	3,320	......	......	......
Oil fuel capacity (tons)	1,050	3,400	3,400	620	710	520	3,480	4,250	3,250	3,400
Armament	10 13.5 in. 12 6 in. 4 21 in. T.T.	8 15 in. 12 6 in. 4 21 in. T.T.	8 15 in. 14 6 in. 4 21 in. T.T.	14 12 in. 20 6 in. 2 21 in. T.T.	10 13.5 in. 16 6 in. 4 21 in. T.T.	10 14 in. 14 6 in. 4 21 in. T.T.	8 13.5 in. 12 6 in. 4 21 in. T.T.	6 15 in. 17 4 in. 2 21 in. T.T.	4 15 in. 18 4 in. 14 21 in. T.T.	...... 10 5.5 in. 18 21 in. T.T.
Armor—Side, amidships	12 in. 9 in. 8 in.	13 in. 6 in.	13 in., 6 in.	9 in., 6 in.	12 in. 9 in. 8 in.	9 in. 7 in. 4½ in.	9 in., 6 in., 5 in.	6 in., 1½ in.	3 in.	3 in.
Side, forward and aft	6 in., 4 in.	6 in., 4 in.	6 in., 4 in.	6 in., 4 in.	6 in., 4 in.	6 in., 4 in.	4 in.	4 in., 3 in.	2 in. forward	2 in. forward
Bulkheads, forward and aft	8 in. 6 in. 4 in.	6 in., 4 in.	6 in., 4 in.	6 in., 3 in.	8 in., 5 in., 4 in.	4½ in., 4 in.	4 in., 2 in.	4 in., 3 in.	3 in., 2 in.	3 in., 2 in.
Barbettes	10 in. to 3 in.	10 in. to 4 in.	10 in. to 4 in.	9 in. to 3 in.	10 in. to 3 in.	10 in. to 4 in.	9 in. to 3 in.	7 in. to 4 in.	7 in. to 3 in.	7 in. to 3 in.
Gunhouses	11 in.	11 in.	11 in.	12 in., 8 in.	11 in.	10 in.	9 in.	11 in. to 7 in.	9 in., 7 in.	7 in.
Conning tower	11 in.	11 in.	11 in., 6 in.	12 in.	12 in.	11 in.	10 in.	10 in.	10 in.	10 in.
Protection—Vertical plating	1½ in. 1 in.	2 in. 1 in.	1½ in., 1 in.	1½ in. 1 in.	1½ in.	2 in., 1½ in.	2½ in., 1½ in., 1 in.	1½ in.	1½ in., 1 in.	1 in.
Forecastle deck	1 in. amidships	1 in.	1 in.	1½ in. amidships	1½ in. amidsh.	1 in. amidships	1½ in., 1 in.	1½ in., 1⅛ in.	1 in.	1 in.
Upper "	2 in. to 1¼ in.	2 in. to 1¼ in.	1½ in. to 1¼ in.	1½ in.	1½ in.	1½ in.	1½ in., 1 in.	½ in.	1 in.	1 in.
Main "	1½ in. at ends	1¼ in. at ends	2 in. 1½ in. 1 in.	1½ in. 1 in. at ends	1½ in.	1½ in. att	1 in. at ends	3 in. to 1 in.	1¾ in., ¾ in.	1¾ in., ¾ in.
Middle "	2½ in. 1 in.	1 in. amidships	2 in. slope main to middle	1½ in. 1 in.	3 in., 1 in.	1 in.	......	......	......	......
Lower "	2½ in. 1 in.	3 in. 1 in.	1 in. 2½ in. 3 in. 4 in.	2½ in. 1 in.	....	4 in. 2 in.	3 in., 1 in.	2½ in.	3 in., 1 in.	3 in., 1 in.

Particulars of Light Cruisers, Monitors, Destroyers, T.B.D. Flotilla Leaders, Patrol Boats, Sloops, Paddle and Twin-screw Mine-sweepers, and "China" Gunboats are given overleaf.

	Submarines					
	"*E*" Class	"*G*" Class	"*H*" Class	"*J*" Class	"*K*" Class	"*L*" Class
Length between perpendiculars	180 ft. 0 in.	185 ft. 0 in.	164 ft. 6 in	270 ft. 0 in.	334 ft. 0 in.	222 ft. 0 in.
Length overall	181 ft. 0 in.	187 ft. 0 in.	171 ft. 0 in.	275 ft. 0 in.	338 ft. 0 in.	231 ft. 0 in.
Breadth, extreme	22 ft. 6 in.	22 ft. 6 in.	15 ft. 9 in.	23 ft. 0 in.	26 ft. 6 in.	23 ft. 6 in.
Load draft, mean	12 ft. 6 in.	13 ft. 3 in.	11 ft. 3 in.	14 ft. 0 in.	16 ft. 0 in.	13 ft. 6 in.
Displacement in tons, surface	660	700	440	1,210	1,880	890
Displacement in tons, submerged	800	975	500	1,820	2,650	1,070
Shaft horsepower of engines, surface	1,600	1,600	480	3,600	10,000	2,400
Shaft horsepower of engines submerged	840	840	320	3,150	1,400	1,600
Speed at load draft (knots), surface	15	14	13	19	24	17¼
Speed at load draft submerged	10	10	10½	9½	9	10½
Oil fuel capacity (tons)	45	44	16	91	200	76
Armament	1-3 in. 5-18 in. T.T.	1-3 in. 4-18 in. 1-21 in. T.T.	.... 4-21 in. T.T.	1-3 in. or 4 in. 6-18 in. T.T.	1-4 in. 1-3 in. H.A. 8-18 in. T.T.	1-3 in. or 4 in. 6-18 in. T.T.

	Light Cruisers				Monitors						
	Arethusa	*Calliope*	"*D*" Class	*Raleigh*	*Humber*	14-in. Gun Class	12-in. Gun Class	*Marshal Soult*	*Erebus*	9.2-in. Gun Class	6-in. Gun Class
Length between perpendiculars	410 ft. 0 in.	420 ft. 0 in.	445 ft. 0 in.	565 ft. 0 in.	261 ft. 6 in.	320 ft. 0 in.	320 ft. 0 in.	340 ft. 0 in.	380 ft. 0 in.	170 ft. 0 in.	170 ft. 0 in.
Length overall	436 ft. 0 in.	446 ft. 0 in.	471 ft. 0 in.	605 ft. 0 in	266 ft. 9 in.	334 ft. 6 in.	335 ft. 6 in.	355 ft. 8 in.	405 ft. 0 in.	177 ft. 0 in.	177 ft. 0 in.
Breadth, extreme	39 ft 0 in.	41 ft. 6 in.	46 ft. 0 in.	65 ft. 0 in.	49 ft. 0 in.	90 ft. 0 in.	87 ft. 0 in.	90 ft. 3 in.	88 ft. 0 in.	31 ft. 0 in.	31 ft. 0 in.
Load draft, mean	13 ft. 6 in.	13 ft. 6 in.	14 ft. 3 in.	17 ft. 3 in.	4 ft. 9 in.	10 ft. 0 in.	10 ft. 0 in.	10 ft. 3 in.	11 ft. 0 in.	6 ft. 0 in.	4 ft. 0 in.
Displacement in tons	3,500	3,750	4,650	9,750	1,260	6,150	5,900	6,670	8,000	540	355
Shaft horsepower of engines	40,000	40,000	40,000	60,000	1,450	2,000	2,300 to 2,500	1,500	6,000	480 to 800	400
Speed at load draft (knots)	29	29	29	30	12	6 to 7	6 to 7	6 to 7	12	12 to 13	10
Fuel at load draft (tons)	260	300	300	1,000	50	200	200	100	220	....	....
Coal capacity (tons)	....	....	....	800	187	400	350	....	....	....	....
Oil fuel capacity (tons)	810	920	1,050	1,600	90	....	....	235	750	30	45
Armament	2 6 in. 7 4 in. (1 H.A. 8 21 in. T.T.	2 6 in. 8 4 in. 4 21 in. T.T.	6 6 in. 2 3 in. H.A. 12 21 in. T.T.	7 7.5 in. 12 3 in. (4 H.A.) 6 21 in. T.T	3-6 in. 2 4.7 in. Howitzers	2 14 in. 1 6 in.	2 12 in. 1 to 4 6 in.	2 15 in. 8 4 in.	2 15 in. 8 4 in.	1 9.2 in. 1 3 in.	2 6 in. 1 6-pounder
Armor—Side, amidships	3 in.	3 in.	3 in.	3 in. 2 in.	....	....	....	....	....	....	....
Side, forward and aft	2 in., 1½ in.	2 in. 1½ in.	2 in., 1¾ in., 1½ in.	2½ in., 1½ in.	....	....	....	....	....	....	....
Bulkheads, fore and aft	....	....	1 in. aft.	1 in. aft	....	4 in.	6 in.	4 in.	4 in.	....	....
Barbettes	....	....	....	....	....	8 in. to 2 in.	8 in. to 2 in.	8 in.	8 in.	....	....
Gunhouses	....	....	....	....	....	10 in., 7 in., 4 in.	10½ in., 5½ in., 4 in., 2 in.	13 in., 11 in., 4¼ in.	13 in., 11 in., 4¼ in.	....	....
Conning tower	6 in.	6 in.	....	3 in.	....	6 in.	6 in.	6 in.	6 in.	....	....
Protection—Vertical plating	....	....	....	....	....	1½ in.	1 in.	1 in.	1 in.	....	....
Forecastle deck	....	....	....	....	....	1 in.	1 in.	1 in.	1 in.	....	....
Upper "	1 in. amidships	1 in. amidships	1 in. amidships	1 in. amidships	....	2 in. to 4 in. on slope	2 in. to 6 in. on slope	1½ in., 2 in. to 4 in. on slope	2 in. to 4 in. on slope	....	....
Main "	....	....	....	....	....	1½ in., 1 in.	1½ in., 1 in.	1½ in., 1 in.	1½ in., 1 in.	....	....
Lower "	1 in. aft	1 in. aft	1 in. aft	1 in. aft	....	....	....	....	....	....	....

	Torpedo-Boat Destroyers			T.B.D. Flotilla Leaders		Patrol Boats	Sloops and Mine-sweepers			"China" Gunboats	
	"*M*" Class	"*R*" and "*S*" Classes	"*V*" and "*W*" Classes	*Kempenfelt* Class.	*Scott* Class and *Shakespeare* Class (approx. same).	"*P*" Class.	Single-screw Sloops "*Flower*" Class	Paddle Mine-sweepers	Twin-screw Mine-sweepers	"*Fly*" Class	"*Insect*" Class
Length between perpendiculars	265 ft. 0 in.	265 ft. 0 in.	300 ft. 0 in.	315 ft. 0 in.	320 ft. 0 in.	230 ft. 0 in.	255 ft. 3 in.	235 ft. 0 in.	220 ft. 0 in.	120 ft. 0 in.	230 ft. 0 in.
Length overall	273 ft. 4 in.	276 ft. 0 in.	312 ft. 0 in.	325 ft. 0 in.	332 ft. 6 in.	244 ft. 6 in.	267 ft. 9 in.	245 ft. 9 in.	231 ft. 0 in.	126 ft. 0 in.	237 ft. 6 in.
Breadth, extreme	26 ft. 8 in.	26 ft. 8 in.	29 ft. 6 in.	31 ft. 9 in.	31 ft. 9 in.	23 ft. 9 in.	33 ft. 6 in.	29 ft. 0 in. (58 ft. ov'r pad'les)	28 ft. 0 in.	20 ft. 0 in.	36 ft. 0 in.
Load draft, mean	8 ft. 8 in.	9 ft. 0 in.	9 ft. 0 in.	10 ft. 0 in.	10 ft. 6 in.	7 ft. 7 in.	11 ft. 0 in.	6 ft. 9 in.	7 ft. 0 in.	2 ft. 0 in.	4 ft. 0 in.
Displacement in tons	1,025	1,065	1,300	1,650	1,800	573	1,250	810	750	98	645
Shaft horsepower of engines	25,000	27,000	27,000	36 000	40,000 to 44,000	4,000	2,400	1,400	1,800	175	2,000
Speed at load draft (knots)	34	36	34	34	36	22	17	15	16	10	14
Fuel at load draft (tons)	140	150	185	255	250	50	130	....	....	....	....
Coal capacity (tons)	....	....	....	....	....	....	260	150	140	5	35
Oil fuel capacity (tons)	280	300	370	515	500	93	....	....	....	10	54
Armament	3 4 in. 1 2-pounder 4 21 in. T.T.	3 4 in. 1 2-pounder 4 21 in. T.T.	4 4 in. or 4.7 in. 1 3 in. 4 or 6 21 in. T.T.	4 4-in. 2 2-pounders 4 21 in. T.T.	5 4.7 in. 1 3 in. H.A. 6 21 in. T.T.	1 4 in. 1 2-pounder 2 14 in. T.T.	2 4 in. or 4.7 in. 2 3-pounders	1 3 in. 1 6-pdr. 2 2-pdrs.	1 3 in. 1 6-pd r. 2 2-pdrs.	1 4 in. 1 3 in. 1 6-pdr.	2 6 in. 2 3 in. ....

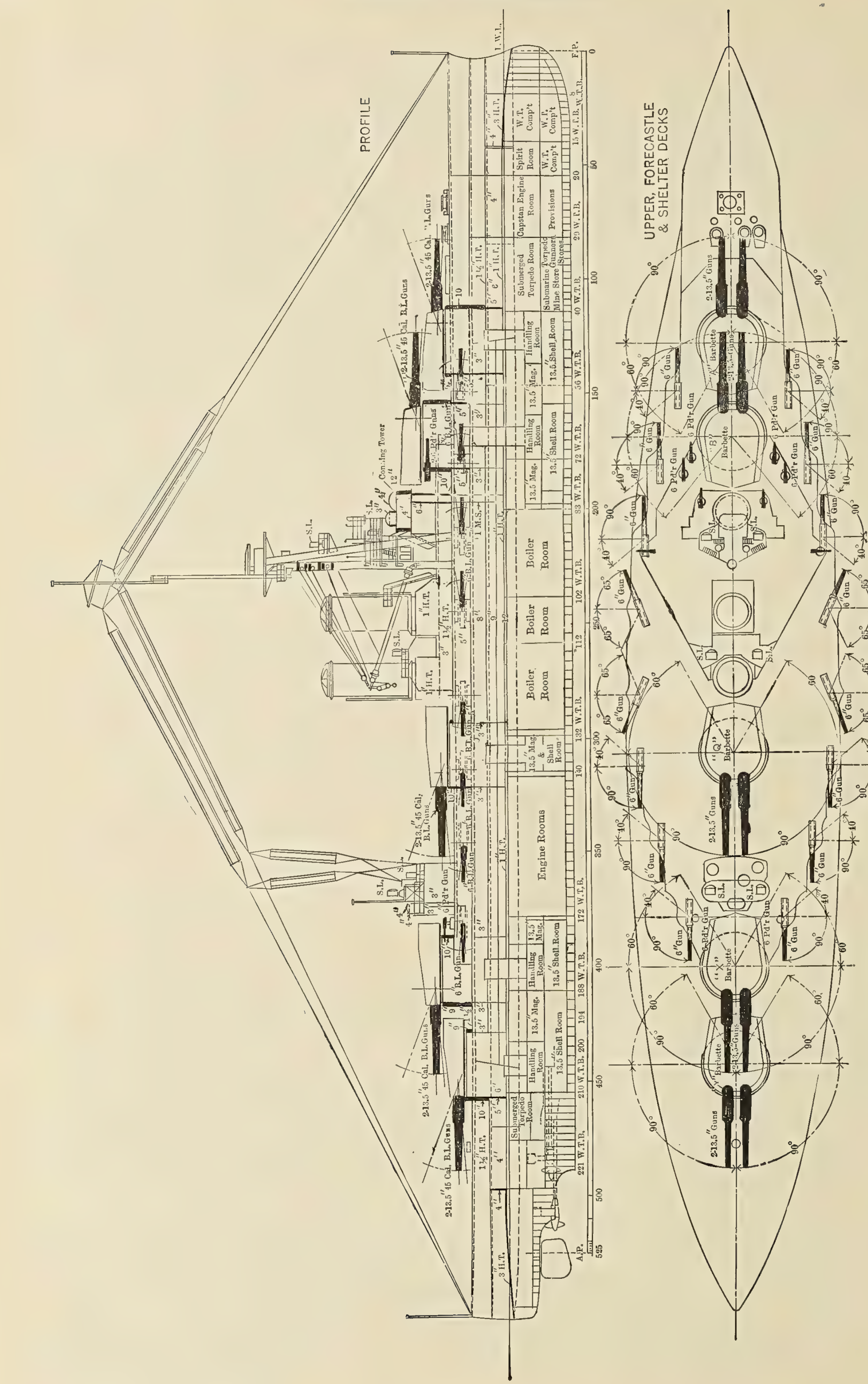


Fig. 8.—H. M. S. *Erin*, Taken Over from the Turkish Government by Great Britain in 1914

the design constitutes a record in design and construction of two such important vessels and reflects great credit, not only upon the Royal Corps of Naval Constructors, but also upon the contractors and all concerned in the construction and completion of the vessels. In fact, the Admiralty conveyed their appreciation of this to me in a letter dated September, 1916.

Large Light Cruisers "Courageous," "Glorious" and "Furious"

While the designs of *Renown* and *Repulse* were in progress, I received instructions to design some very high-speed ships carrying powerful guns of a size sufficient to keep their speed in moderate weather, but to have a draft lighter than any existing British or enemy ship of the same class, so as to be able to navigate shallow waters, if required.

As sanction was not likely to be obtained for building more capital ships taking two years or longer to complete, while additional light cruisers had been already approved of, it was decided to build *Courageous* and *Glorious* on the lines of very large light cruisers mounting a few guns of heaviest calibre, so as to be able to annihilate any enemy light cruisers or raiders. They were to have thin protection, similar to our light cruisers, and a speed of not less than 32 knots, the draft being restricted to about 22 feet, or about 5 feet less than any existing battleship or battle-cruiser carrying such heavy guns, the main armament of four 15-inch guns in two turrets, one forward and one aft, making them a match for any raider or light cruiser that might be encountered. At this time it should also be remembered that the armaments of ships, especially as regards heavy guns, had to be regulated by the guns and gun-mountings which would be available or could be manufactured in the time at our disposal, and this condition applied to the 15-inch mountings which were adopted for these ships. The secondary armament consisted of eighteen 4-inch guns in six triple mountings, similar to the triple mountings of the *Renown* and *Repulse*. The side armor consisted of 2-inch protected plating on top of the 1-inch shell plating, as in our light cruisers, and a thin protective deck was worked all fore and aft, but this was considerably thickened over the magazines after Jutland. A modified bulge was arranged for, as in *Renown* and *Repulse*.

The machinery adopted for these ships was of the type fitted in the light cruiser *Champion*. It consisted of a 4-shaft arrangement of geared turbines, the power being transmitted to the propeller shafts by double helical gearing. The eighteen boilers of Yarrow small tube type were also similar to those of the light cruisers, and with all-oil firing a power of 90,000 shaft horsepower at about 340 revolutions was aimed at. Such trials as it was possible to make showed that 32 knots could easily be obtained at the designed displacement, and reports show that on service this is actually exceeded.

The design of these vessels was begun late in January, 1915, and the order for one ship (*Courageous*) was placed with Messrs. Armstrong and the other (*Glorious*) with Harland & Wolff, the latter making their own machinery and Messrs. Parsons supplying the machinery for Messrs. Armstrong's ship.

It was intended that these vessels should be built in a year, or as near that as possible, but this was not realized, and the ships were both commissioned in October, 1916.

On her commissioning trials, the *Courageous* worked up to full power, and while steaming during the trials at full speed she met very heavy weather. Some signs of weakness were shown at the fore side of the forward turret, where there is an inevitable discontinuity of longitudinal strength, and some doubling plates were accordingly added to the *Courageous*. Her sister vessel *Glorious* was in commission for over a year before similar additions were made to her, although no signs of weakness were shown. This incident shows that the very high speed obtained on trial, reaching 32 knots, should hardly be maintained against head seas in heavy weather.

The *Furious* was similar to, but a modification of, the *Courageous* and *Glorious*, having about the same length and the same machinery, but the form of midship section was somewhat different, having a more pronounced bulge and a simpler form of main framing and structure of the hull. The armament also was different, each turret, instead of having two 15-inch guns, was arranged to carry one big gun of 18-inch bore, although arrangements were made to substitute pairs of 15-inch guns, if thought desirable later.

The order for this ship was placed with Messrs. Armstrong about two months after that of *Courageous*, and she was to be finished in the shortest possible time. Early in the spring of 1917, however, the necessity for having fast aeroplane-carriers became very obvious, and it was approved to fit *Furious* for this purpose. This entailed doing away altogether with the fore turret and making other considerable alterations. A large hangar was built on the forecastle deck, and a flying-off platform 160 feet long was arranged on the roof of the hangar, which was designed to house about ten machines. Later it was decided to remove the after turret as well, and a flying-on deck 300 feet long, extending from the funnel aft, was constructed.

The secondary armament, which had consisted originally of eleven 5½-inch guns, was retained, with the exception of one gun, the remaining ten guns being rearranged. Four sets of triple 21-inch torpedo tubes were fitted on the upper deck aft, and one pair each side on the upper deck forward.

After these alterations were completed, the ship was tried and commissioned in July, 1917, a speed of 31½ knots being obtained with 94,000 shaft horsepower at 330 revolutions.

(*To be continued.*)

New Regulations Approved by Steam-boat-Inspection Service

On March 22, 1919, the Board of Supervising Inspectors, Steamboat-Inspection Service, adjourned, having convened in annual meeting on January 15, 1919.

During the meeting the Board announced the rules and regulations relating to line-carrying projectiles and the means of propelling them, life lines for lifeboats, and approved the Hall line-carrying gun, which action was published in circular letters. The Board further amended rules relating to boilers and attachments, life-saving appliances, licensing of officers of vessels, and other rules, and approved various kinds of life-saving appliances, fire apparatus and pipe boilers.

The action taken on all of the subjects above referred to will shortly be published in a circular letter with title of "Eighteenth Supplement to General Rules and Regulations," which will be furnished steamboat companies, boiler manufacturers and others concerned. When ready for distribution, the circular letter can be obtained from any board of local inspectors, Steamboat-Inspection Service.

SHIPPING POSSIBILITIES OF THE YANGTSE KIANG RIVER

(*For Description of Vessel Shown Below, See Page 396*)

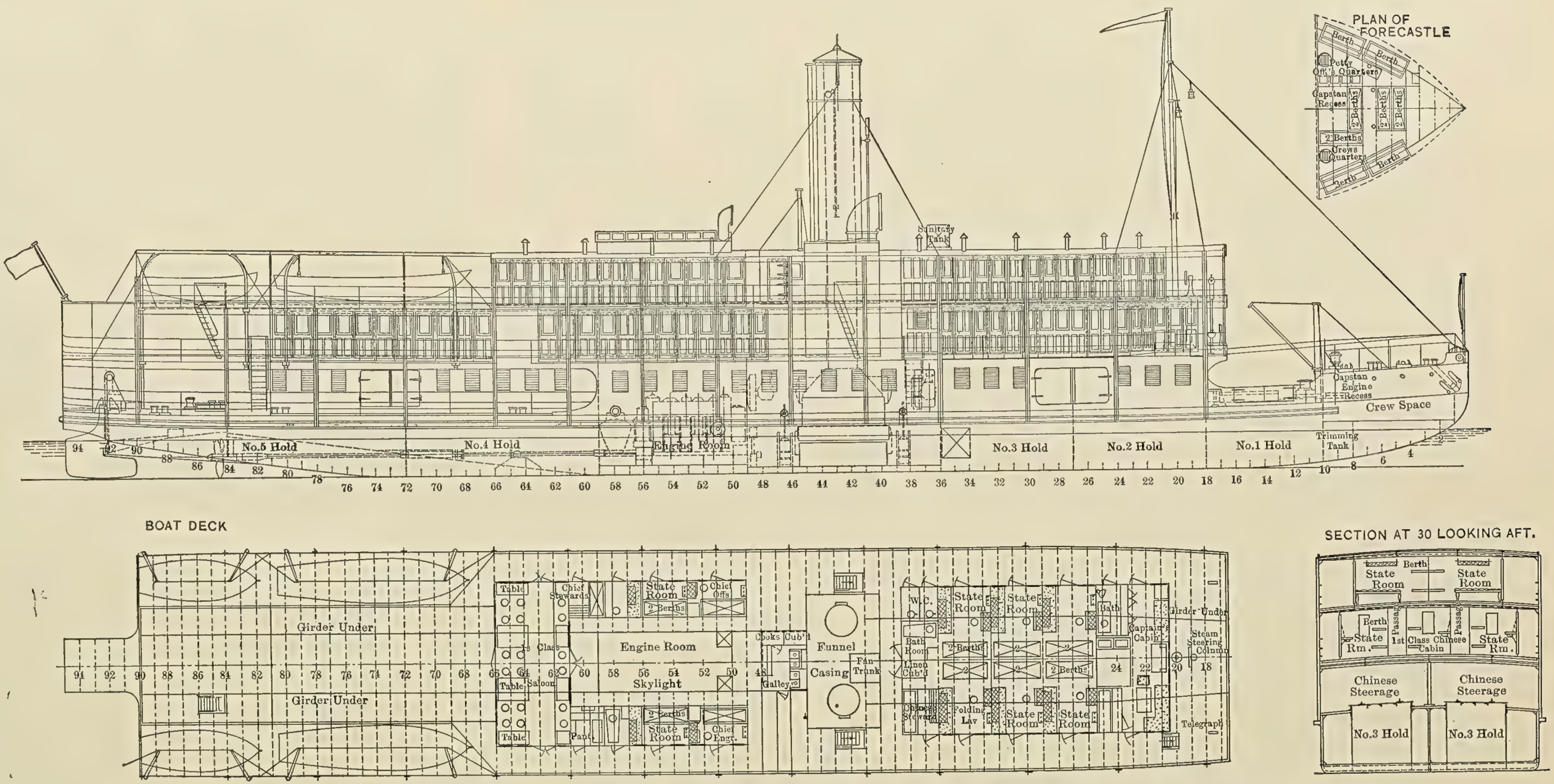


Fig. 1.—Twin-Screw Shallow-Draft Steamer *Shuhun.* Built by Yarrow & Company, Ltd., Glasgow, for Service on the Yangtse Kiang

Fig. 2.—Upper Yangtse Junk

Shipping Possibilities of the Yangtse Kiang River

Naval Commander Discovers Unusual Opportunities for Profitable Shipping on Chinese River—Types of Vessels in Successful Operation

BY LIEUTENANT-COMMANDER H. DELANO, U. S. N.

THE United States gunboat *Palos* had hardly dropped anchor in the whirling waters of the Yangtse Kiang at the port of Ichang, China, one thousand miles from the coast, when the quartermaster-of-the-watch announced that the master of a Chinese merchant vessel wished to see the commanding officer. I expected to see a fat, well-fed native out of a job, who wanted to pilot the ship through the gorges and rapids to Chungking, whither the *Palos* was bound. Much to my surprise a keen-eyed, vigorous American appeared, who announced the fact that he was the last American skipper on the Yangtse.

The trip up river had been very tiresome; the weather was extremely hot; our coal was chiefly dirt, which made steaming difficult, and to add to our already numerous difficulties, every junk we met seemed bent on colliding with us, thereby causing us to steam miles out of our way to avoid them. So naturally all hands were tired and would have preferred turning in rather than entertaining a stranger. The first words of Captain Brown, as I shall call him, sounded promising; it was apparent that he needed no entertainment, so we lighted our pipes, got under the electric fans and listened to his story.

The Captain's Story

"For twenty-five years," Captain Brown began, "I have steamed up and down this river and along the coast. When I first came out I served as mate on a small coastwise steamer—rotten craft even in those days, but they flew the American flag, which helped some. The river business began to boom, so I came up here and got my own boat, a new one of the China Merchants Line. You've seen her—the stern-wheeler now on the Changsha run, modelled after Mississippi steamboats. When I came up river, Chinese steamers flew the American flag because American capital was invested. The only other foreign flag was British; the Japs hadn't horned in yet."

Captain Brown paused an instant for breath, then bringing his fist down upon the table with a bang, asserted, "There is money to be taken out of this river! The lower Yangtse lacks a lot of being crowded with shipping, while the upper river is as deserted as the Dead Sea. There is where a barrel of money can be made by a live American with sufficient capital to make a start."

Here Captain Brown hesitated long enough for me to interpose a question. "What," I asked, "is the reason why there is practically no shipping on the upper river when, as you state, a gold mine awaits the shipowner who operates up there?" The captain's reply was prompt. "The Chinese have filled the gorges with terrible traditions," he said. "Their tales make the rapids look like waterfalls to the folks living in the flat country. These people down here are bluffed, and that is all there is to it. The people who have the money listen to these tales and then duck. None of you officers has navigated the rapids, but you are going through in a few days. You don't look like you are going to a funeral, and your ship isn't built for the upper river, either. Look at the *Shuhun.* Paid for herself the first year and still running, making a mint of money for her owners every year and good for several years still.

"There is no doubt in my mind about the wonderful chances for an American shipping company on the upper Yangtse, and that is why I came to see you. I have thought this thing out and am trying to interest capital. I may have to go to the States for backing, but I am giving Americans out here the first chance. However, you people are probably tired, so I will not bother you to-night. Have tiffin with me on my boat to-morrow and I will explain my plans." The captain left the ship and we retired.

The Mission of the Palos

The *Palos* was en route to Chungking Szechwan, West China, her station for the winter. Her function was to

"show the flag and to protect American interests." Four hundred cases of stores ranging from boxes of tinned tomatoes to bales of waste had been shipped to Ichang for transshipment to Chungking, and the first thing to do was to arrange for shipment to go forward. Early the following morning I set out to accomplish this. At this time—midsummer of 1916—four companies were operating steamers between Ichang and Chungking. The Teh Yeh Company operated one steamer, the Lien Hwa, 366 gross tonnage and 13 knots, flying the Jardine Matheson house flag, a British concern. This steamer made several trips, but, due to lack of boiler power, could not be relied upon for regular service.

The Szechwan Railway Company operated the steamer *Tachuen*, 250 gross tonnage, 13 knots. This steamer is

Fig. 3.—U. S. Gunboat *Palos*

still operating at a profit. Later in the year two additional steamers, the *Chu Chuen* and *Chi Chuen*, were put on the run. Their gross tonnage is 825, speed 11.5 knots; but they were under-boilered and could not make their designed speed, so were eventually laid up at Ichang.

The Szechwan Steam Navigating Company was the only successful operating Company. In 1909 this company began operating the *Shutung*, a small steamer of 37 registered tons, which towed a barge of 159 tons capacity alongside. The Shutung was built in England and was so successful that the Shuhun was laid down. This steamer was designed for a deadweight capacity of about 300 tons, with a speed of 14 knots.

Cargo Space on the River Boats at a Premium

Knowing the number of steamers supposedly in operation, I thought my task of obtaining cargo space would be fairly simple. I was soon disillusioned, for every agent had the same formula ready—"No space." We simply had to ship the stores, but even the extra inducement of a higher rate failed miserably. I thought of Captain Brown and his scheme and took a sampan out to his ship with considerably more interest than I had had the night before.

After a good lunch the captain unfolded his plans. "The *Shuhun* is the best boat on the upper Yangtse," he began; "she has plenty of speed and sufficient cargo space to turn over a nice profit at the end of each run. I propose to have two such steamers to start with, owned by an American company, flying the American flag. You failed to get cargo space because there are several thousand tons ahead of you. My steamers will help carry that tonnage.

"Examine these customs reports of last year," he continued, displaying voluminous reports of the year 1915; "see the amount of business carried on between Ichang and Chungking! Apply the prevailing freight rates and you can figure for yourself that my boats will pay for themselves the first year and turn out a good profit besides." Here the captain's pride asserted itself. "If Chinese," he said, "can operate steamers through the gorges and rapids, so can I." After talking for an hour or more, examining the data he had compiled, and discussing details of organization, I went away convinced.

Our stores had to be shipped, so I went ashore to make another attempt to obtain shipping space. Freight charges go to the company, but "cumshaw" does not; therefore, but one course was open. A few substantial presents judiciously bestowed resulted in placing 225 packages. Sixty packages measuring 102 cubic feet were billed out on the *Chu Chuen* at $1.00 U. S. C. per cubic foot. One hundred and twenty-five, 212.5 cubic feet, were billed out on the *Lien Hwa* at $1.05 U. S. C. per cubic foot. Forty packages, 68 cubic feet, were billed out on the *Shuhun* at $1.08 U. S. C. per cubic foot. The remaining 175 packages were billed out on two large junks at $.95 U. S. C. per cubic foot, and the following day started on their two-months' trip to Chungking. The total cost of shipments can readily be seen; but, high as it was, the commissioner of customs thought we were very fortunate to obtain space at all.

Possibilities for Shipping on the Upper Yangtse

The object of this article is to show American shipping men the possibilities that exist on the upper Yangtse. The resources of the country are practically untapped and will remain so until adequate transportation is available. The Szechwan Steam Navigation Company's steamers *Shutung* and *Shuhun* have made good. They have successfully navigated the waters of the turbulent river, through beautiful gorges and over strong rapids, for years. Yet even at present there is more freight awaiting shipment than the steamers now operating can handle. The *Shutung* is too small to constitute a good investment, but the *Shuhun* is well designed and represents the best type of steamer for this service, therefore a brief description of this vessel is given.

Twin-Screw, Tunnel-Stern Steamer Shuhun

The *Shuhun* was designed by Captain S. C. Plant, the premier navigator of the upper Yangtse, and was built by Yarrow & Company, Glasgow, in 1914 at a cost of $112,000, U. S. C. Captain Plant's aim was to obtain a

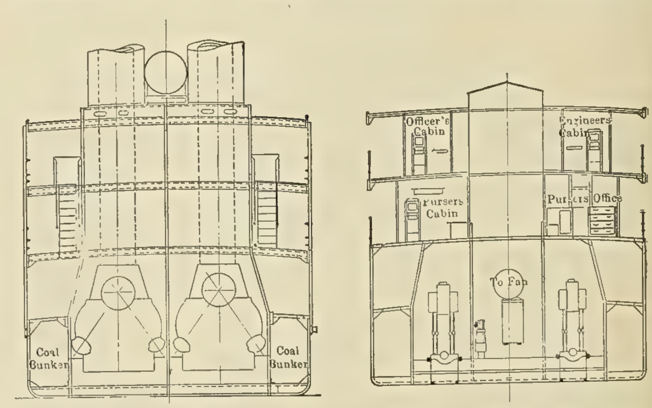


Fig. 4.—Sections Through Machinery Space of the *Shuhun*

vessel sufficiently powerful to negotiate the rapids under her own steam without the assistance of warping lines, and at the same time to be large enough to contain sufficient cargo space in order that it might operate at a profit.

The designs contemplated a length of 190 feet, beam of 30 feet, and a draft of 5 feet, with a full cargo load of 300 tons. Machinery was designed to develop 2,000 horsepower at a speed of 14 knots. While building, designs

were altered somewhat, with resultant characteristics as follows: Length, 194 feet; beam, 30 feet 10 inches; draft under full loading, 5 feet 6 inches. The general features of design are fully shown on the plates reproduced by courtesy of *Engineering*, London, which published an article descriptive of the *Shuhun* in their issue of November 6, 1914.

The hull is divided into nineteen compartments by longitudinal and transverse bulkheads, fitted with watertight doors. There are four decks—main, upper, boat and awning. Accommodation for European passengers and the officers is on the boat deck and consists of a dining salon and eight 2-berth staterooms for passengers, also captain's, chief officer's and chief engineer's cabins, pantry, galley, bathrooms and toilets, and steward's cabin. Chinese first and second class passengers are quartered on the upper deck, the quarters consisting of a first class dining salon and eight first class, 2-berth staterooms, a second class salon and eleven 4-berth staterooms, purser's cabin and office and assistant purser's cabin. On the main deck there are accommodations for 170 native steerage passengers, fifteen firemen and three engineers. In actual service, however, means have been found for the accommodation of 300 steerage passengers. In the forecastle there are accommodations for four petty officers and twelve men, also a mess room for fourteen cooks and boys.

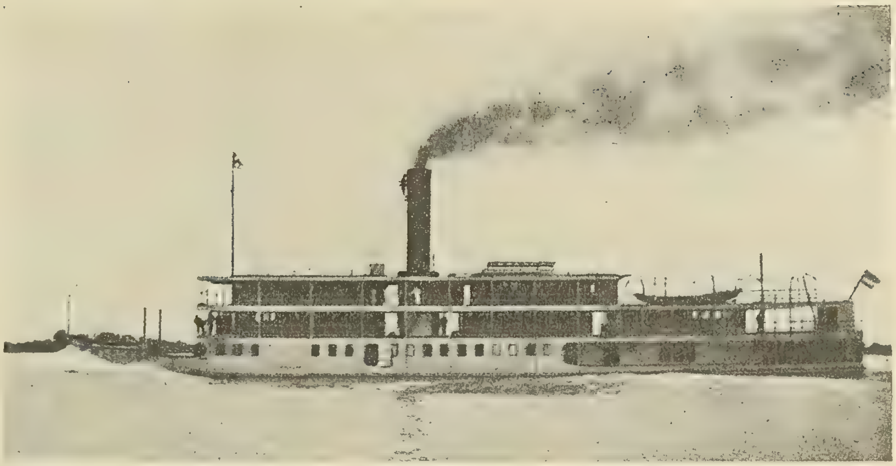


Fig. 5.—River Steamer *Shuhun*

Propelling Machinery

The propelling machinery consists of two vertical inverted triple-expansion engines designed to develop 2,000 horsepower at 14 knots. Two double-ended watertube coal-burning boilers are installed. On account of the necessity for quick increase of speed to full power, oil fuel may be used in conjunction with coal. In practice, however, the use of oil has been found unnecessary.

The propellers work in tunnels, the after ends of which may be partially or wholly closed by hinged flaps. The flaps work automatically, so that at all conditions of displacement and draft they are always in the most efficient position.

In order to preclude the possibility of the vessel being deflected from its course when entering a rapid, also to provide sufficient rudder area for proper steering when steaming through swirls and whirlpools, three balanced rudders actuated by hand and steam power are provided. There are two steam steering stations, one on the upper bridge and one in the wheelhouse. The hand steering station is also in the wheel house. The steam steering engine is located in the engine room. With both engines working at half power, the vessel turns within two lengths.

There are five separate cargo holds having a total capacity of 16,000 cubic feet, and on a draft of 5 feet the vessel has a deadweight capacity of 300 tons. The vessel is lighted throughout by electricity, current being supplied by an oil-driven dynamo.

An Opportunity for American Shipping

The only means by which merchandise may be taken out of the provinces of Hupeh and Szechwan is by river. Although certain railway concessions have been granted, no roads have been built in this locality, and, due to the nature of the country, it must of necessity be years before railroad facilities are available for extensive use. In the meantime, the shipping industry will be built up with profit to whoever engages in it. Those persons may as well be Americans as any other nationality.

At the freight and passenger rates prevailing in 1916—which have not decreased, but, on the contrary, have materially increased—approximate receipts and expenditures may be determined, and thus an idea of the character of such an investment may be readily seen. For this purpose the following figures are shown:

ANNUAL RECEIPTS

16,000 cubic feet of cargo at $1.00	$16,000.00
16 first class passengers at $43.00	688.00
44 second class passengers at $21.50	946.00
170 steerage passengers at $10.00	1,700.00
Total, up trip	$19,334.00
Down trip, rates reduced one-half	9,667.00
Total, round trips	$29,001.00
Two round trips per month for 8 months, total annual receipts	$464,016.00

OPERATING EXPENSES PER MONTH

180 tons of coal at $4.50 per ton	$810.00	
150 gallons of oil at .75 per gallon	112.50	
Master	150.00	
Chief engineer	100.00	
2 pilots	90.00	
15 firemen, 3 engineers, 12 deck hands, 4 petty officers, 14 cooks and boys	720.00	
Total per month	$1,982.50	
Total for eight months		$15,856.00
Annual repairs, 20 percent of cost of vessel, assuming $150,000 as cost		30,000.00
Cost of maintenance while laid up for repairs, 50 percent of operating cost		7,928.00
Annual expenditures, exclusive of miscellaneous stores		$53,784.00

Thus if throughout sixteen round trips a steamer carries full cargo and passenger trip, the excess of receipts over expenditures would be $410,232. If it averages half load and passenger list, the excess would be $178,224.

Ichang, Hupeh province China, is a very important port on the Yangtse Kiang River in a rich agricultural country, 400 miles from Hankow and 350 miles from Chungking. Merchandise bound either way is transshipped at this point. The following data taken from the custom's report of the year 1916 show the amount of tonnage handled during that year:

Steamers entered, 370 tonnage; freight entered, 231,461
Steamers cleared, 367 tonnage; freight cleared, 232,289

The foregoing does not include freight handled by junks and sailing vessels.

Chungking, province of Szechwan, is the largest city in West China and is the shipping port of the province, also drawing from the provinces of Yunnan and Kweichow. The province of Szechwan alone has no less than

sixty million people, and the population of Chungking is estimated at six hundred thousand. The principal exports are silk, skins, wool, wax, hides, bristles, hemp, opium, musk and wood oil. Szechwan contains undeveloped deposits of coal, iron, antimony, copper, and some silver and gold. The mineral deposits must of necessity remain unworked until transportation facilities are more fully developed.

Considerably more freight is handled by junks than steamers, due to the undeveloped state of steam navigation. Junks make the trip up from Ichang to Chungking in an average of eight weeks, and consume two weeks in the trip down.

Customs reports of 1916, showing the tonnage of freight handled during that year, is as follows:

	Tonnage
Steamers entered, 58	15,244
Sailing vessels entered, 1,096	58,150
Total	73,394
Steamers cleared, 62	16,383
Sailing vessels cleared, 809	27,643
Total	44,026

In 1917 the Standard Oil Company began operating the steamer *Meitan* between Ichang and Chungking. This steamer tows a barge alongside designed for carrying oil in bulk and in tins. In the same year the Asiatic Petroleum Company laid down a similar vessel for this service. No better evidence of the future prospects of West China can be had. The country must and will be developed; and even if this development is slow, present trade conditions demand additional steam vessels.

The practicability of navigation of the upper Yangtse for steamers less than two hundred feet in length is not widely known at present. In these reconstruction days, when people of all nationalities are reaching out for business, the possibilities of the upper Yangtse country will become known and the early investors will reap handsome profits. American shipping interests should not allow other nations to be the first on the ground.

Progress of Shipbuilding in China*

After forty-four years of steam navigation in China, the shipping is still largely owned and controlled by foreign interests. In 1917 there were eighty-seven steamships engaged in Chinese coastwise trade, only twenty-seven of which were Chinese-owned; and in March of the same year 1,077 vessels of all types, aggregating 76,425 tons, were plying on inland waters, only one-fifth of which were Chinese-owned. It is natural, therefore, that in attempting to put the country on a self-sustaining basis the Chinese should regard shipbuilding and ship owning as important factors. The remarkable accomplishments which have marked the past few years in Chinese shipbuilding have more than reflected the universal interest in this industry because of war conditions and have registered a certain declaration of independence on the part of Chinese merchants.

Table I

Nationality.	1915.		1916.		1917.	
	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.
Chinese	141,965	24,159,009	136,501	23,397,109	146,900	24,022,817
British	33,339	37,675,657	34,132	35,840,573	34,902	33,576,217
Japanese	20,141	23,873,016	21,598	24,233,835	22,454	24,581,647
Russian	4,[illegible]73	1,922,055	3,790	1,545,085	3,276	1,429,200
American	3,148	804,414	3,082	799,913	3,609	1,125,155
All other	3,421	2,228,854	2,913	2,203,586	2,332	2,172,013
Total	206,887	90,663,005	202,016	88,020,101	213,473	86,907,049

* Prepared by the Latin-American Division, Bureau of Foreign and Domestic Commerce, and published in *Commerce Reports*.

Carrying Trade Shows Decrease

The total shipping tonnage, foreign and coastwise, entering and clearing for the years 1915, 1916 and 1917 was as shown in Table I.

The following figures show the nationality, number and tonnage of ships engaged in the Chinese coasting trade for the year 1917:

Nationality.	Entries.		Clearances.	
	Number.	Tonnage.	Number.	Tonnage.
Chinese	48,185	9,494,867	49,310	9,461,851
British	12,966	13,199,778	12,947	13,112,950
Japanese	8,274	8,653,325	8,338	8,729,463
American	1,425	229,819	1,418	252,977
Russian	1,240	522,866	1,206	508,533
All other	565	317,570	556	297,105
Total	72,655	32,418,225	73,775	32,362,879

The advantage these figures show for Chinese shipping is more apparent than real. Only a small number of the vessels under Chinese ownership are of more than 600 tons, and there are only twenty-seven that can be classed as steamships. Owing to inadequate railroad facilities, any serious decrease in shipping tonnage engaged in coasting trade restricts the inland commerce of the country; thus when the total foreign and coastwise tonnage entered and cleared drops from 90,663,005 tons in 1914 to 86,907,049 tons in 1917, the effect is serious.

War Activities of Chinese Shipyards

The oldest and largest shipbuilding concern in China, the Kiangnan Dock & Engineering Works, at Shanghai, is controlled by the naval board of the Peking Government. Originally designed as a navy yard for repairs to foreign-built Chinese warships, it was placed at the disposal of the United States Government in July, 1918. Arrangements were then made for the construction of four 10,000-ton ocean steamers, and an option was given for eight more of the same capacity, the steel being shipped from the United States and all other material being supplied in China. At the same time the British Government contracted with the Hongkong & Whampoo Dock Company (Ltd.) for six standard steel ships, one of 5,000 tons and five of 8,000 tons each, four of which are to be constructed with American steel. The New Engineering & Shipbuilding Works at Shanghai, which has a capacity for six ships of 5,000 tons, is also building two ocean-going vessels of 2,000 tons each; and the Shanghai Dock & Engineering Company, a British concern with five ways, has undertaken the construction of five standardized ships of 5,000 tons.

The Kiangnan Dock & Engineering Works at Shanghai employs from 1,200 to 1,500 men. When occasion requires, the plant works twenty-four hours a day in three shifts. The yard has twelve ways, is fitted with a modern equipment for construction, and has a dry dock capable of handling vessels up to 544 feet in length. In Shanghai there are about 5,000 men engaged in shipbuilding work, and in Hongkong about twice that number. The Chinese workmen are not nearly as fast as American builders, but their work is equally dependable. Their skilled mechanics are thorough and reliable. When they build a ship it is

put together with the utmost care that mechanical ingenuity makes possible.

Raw Materials and Labor Plentiful

Whereas the steel for the first ocean-going ships to be constructed in China has necessarily been imported, it is predicted that in the near future China, possessing all the necessary raw materials in abundance, will be able to construct and equip ocean-going vessels entirely of domestic materials. There is also abundant timber for wooden-ship construction, and the many small yards capable of turning out one or two vessels up to 600 tons each will not suffer from a shortage of the necessary materials. Eighty million feet of timber are imported annually into Shanghai alone, and a like amount was in storage there in 1917.

It is estimated that there are 300 first-class Chinese ship carpenters in Shanghai capable of working from drawings, and 600 good helpers who can, with suitable supervision, produce work equal to American or European workmen. Although working slower, they are quick to adapt themselves to modern tools and machinery.

Inland and Coastwise Trade

The two leading Chinese shipping companies are the China Merchant Navigation Company and the Ningpo-Shaohsing Steam Navigation Company. The former, established in 1873, has co-operated with the Government since 1892, and has also worked hand in hand with the leading foreign shipping concerns. The following is a list of ships owned by this company:

Name of Ship.	Line.	Year Built.	Tonnage.
Fung-shun	Peiyang	1875	1,300
Toonan	do	1881	2,800
Poo-chi	do	1882	1,100
Fei-ching	do	1883	1,539
Kwang-chi	do	1887	505
Hsin-yu	do	1889	1,629
Hsing-fung	do	1891	1,846
Hsing-ch'	do	1892	1,846
Kung-ping	do	1894	2,475
Anp'ng	do	1897	1,857
ai-shun	do	1897	1,962
Yu-shun	do	1900	2,962
Hs'n-chang	do	1905	2,000
Hsing-kang	do	1906	2,146
Hsing-ming	do	1906	2,100
Kiang-foo	Yangtse	1873	4,000
Kiang-yu	do	1873	4,000
Kiang-yung	do	1876	3,500
Kiang-kwan	do	1876	5,500
Kiang-hsin	do	1905	3,372
Kuling	Hankow-Ichang	1885	250
Kwei-lee	do	1893	879
Kiang-tien	Ningpo	1870	3,800
Hai-tien	Wenchow	1874	1,300
Hai-an	Fuchow	1874	1,300
Irene	Amoy-Swatow	1890	1,343
Chi-yuan	Hongkong-Canton	1891	3,000
Kwang-lee	do	1883	3,000
Kwang-tah	do	1883	3,000
Mei-foo	do	1870	2,500
Kiang-tung	Canton-Macao	1870	566

The Ningshoa Steamship Company has two vessels, of 1,300 and 999 tons, respectively, which ply between Ningpo and Shanghai, and up the Yangtse River to Hankow. Two companies, the Yuen On and the Shiu On, maintain a ferry service between Hongkong and Canton; the Szechwan Steam Navigation Company operates two steamers on the upper Yangtse Rapids, and three other small steamers, owned by Chinese companies, also operate on this waterway.

In addition to the above, motor-boat service is maintained on the Kueikiang River in South China, with an extension on the West River, despite the difficulties of navigation at some seasons of low water. These boats are of about 60 tons and burn liquid fuel.

There is little doubt but that the present war incentive to Chinese shipbuilding will witness a replacement of the old and slow vessels with newer and faster types. It may even lead to the creation of a large seagoing fleet of Chinese vessels. The war has awakened China to its capabilities as a shipbuilder, and experience has shown China the advantages of being a shipowner. With the proper encouragement the shipping industry there may prove itself only the harbinger of industrial awakening and the forerunner of economic independence.

Registered Japanese Shipping

The *Japan Advertiser* states that, according to latest investigations made by the Department of Communications, the vessels registered in Japan at the end of December, 1918, consisted of 2,641 steamers, aggregating 2,310,959 tons, and 12,431 sailing vessels of 857,556 tons. Steamers over 1,000 tons numbered 616, with a gross tonnage of 1,859,349, the particulars being as follows:

Classification	Number	Gross Tonnage
1,000 to 2,000 tons	237	334,088
2,000 to 3,000 tons	144	348,354
3,000 to 4,000 tons	96	320,907
4,000 to 5,000 tons	39	175,948
5,000 to 6,000 tons	49	279,513
6,000 to 7,000 tons	23	146,199
7,000 to 8,000 tons	13	98,266
8,000 to 9,000 tons	1	8,150
9,000 to 10,000 tons	8	76,028
Over 10,000 tons	6	71,896
Total	616	1,859,349

During the war boom in 1917, the shipbuilding slips in Japan totaled 145, but about 40 of the smaller shipyards, established to take advantage of the boom, have since been closed, so the present number of slips is 105. This loss occurred chiefly in slips for small vessels, which were built by shipyards of comparatively limited means, and it is said that in future efforts will be concentrated on the construction of large vessels, though at present the Japanese shipbuilding industry is very depressed.

Composite Ships Being Fitted with Diagonal Strapping

An innovation in composite ship construction was introduced recently by R. A. Polhamus, naval architect of the Mobile Shipbuilding Company, Mobile, Ala., with the view of adding strength to the hull and eliminating vibration. This innovation, consisting of diagonal strapping in the hull, was first utilized in the *Dalgada*, the third of a fleet of six 3,500-ton composite vessels for the Emergency Fleet Corporation.

On the trial trip of this vessel there was a noticeable absence of vibration, and so well pleased were the executives of the company with the results that it was decided to install the strapping in the three remaining ships, the *Balosara*, *Obak* and *Oyaka*. The pleasing surprise came when the *Morganza*, the second ship of the fleet built by the Mobile company, was ordered to Mobile from New Orleans to be fitted with the strapping. The *Morganza*, since acceptance, has been operating for the United Fruit Company out of New Orleans to Cuba. The *Buckhannon*, of similar type, built at Slidell, La., which is also at the Mobile yard for additional work, is likewise being fitted with the diagonal strapping at the order of the Emergency Fleet Corporation.

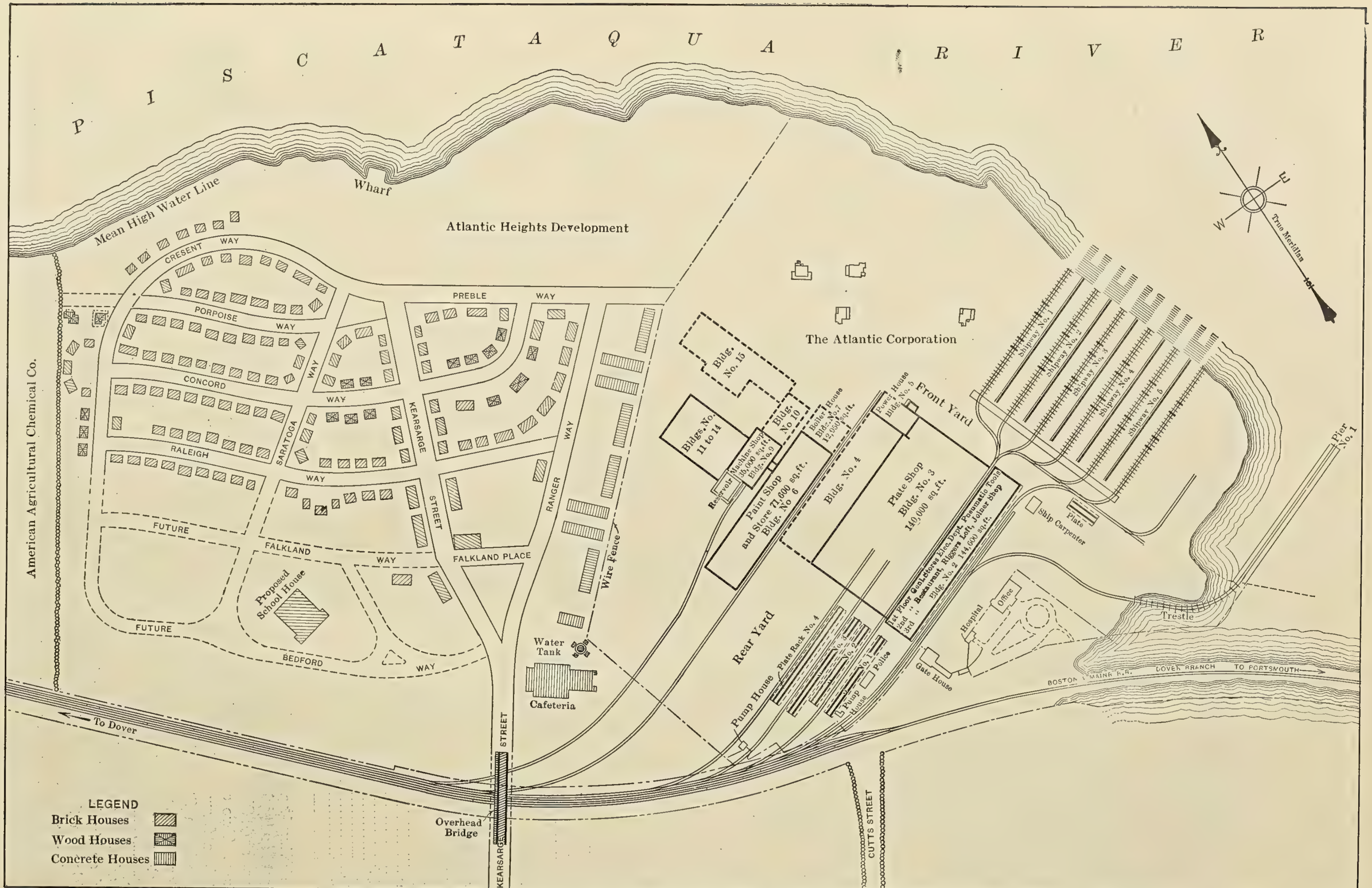


Fig. 1.—General Plan of Shipyard of Atlantic Corporation at Portsmouth, N. H., and Atlantic Heights Housing Development

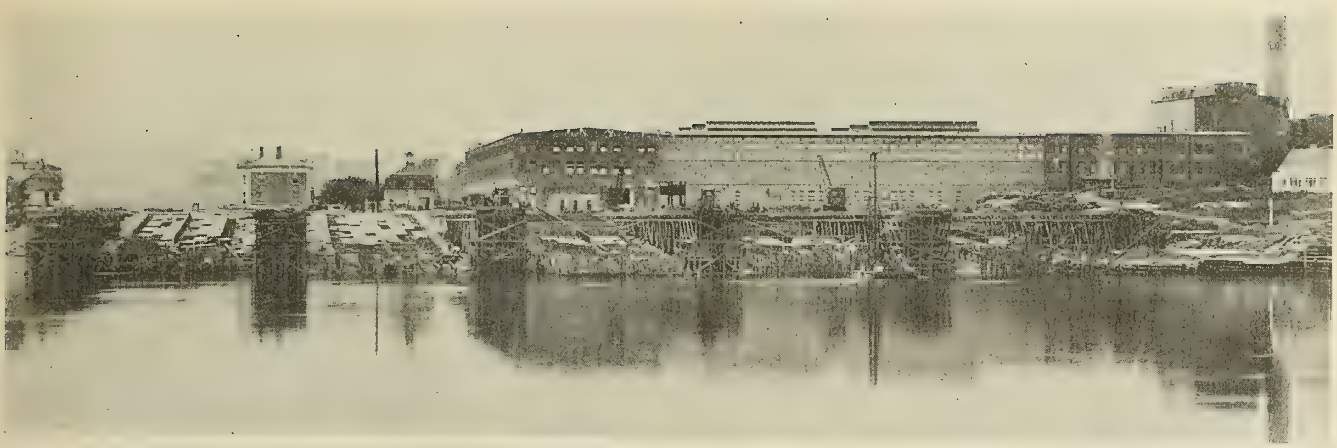


Fig. 2.—Waterfront of Atlantic Corporation Yard

Shipyard of the Atlantic Corporation

Five-Way Plant for Building Steel Ships Established at Portsmouth, N. H.—Facilities for Training and Housing Workmen

BY C. E. DOWNTON

THE Atlantic Corporation, Portsmouth, N. H., was organized in December, 1917, for the purpose of building steel cargo ships for the United States Shipping Board Emergency Fleet Corporation. Ten vessels of the *Robert Dollar* type were allotted under a contract that called for the complete fabrication, construction and equipment of the ships ready to receive crew and cargo.

The yard, which was secured through purchase of the plant of the Colonial Paper Company, consists of 125 acres of land located at Freeman's Point, one mile northwest of the city of Portsmouth on the banks of the Piscataqua River, a district made famous through the shipbuilding achievements of our first admiral, John Paul Jones, who personally supervised the construction of many naval vessels used in our country's early struggles for independence. Among them were the *American* and *Ranger,* which rank with the best of our early battleships. Furthermore, the latter was the first ship to hoist the "Stars and Stripes" to its masthead.

Famous Ships Built at Portsmouth

Later history records the building of the *Kearsarge,* Admiral Farragut's flagship, and many noted clipper ships of the kind comprising our early merchant marine in the days when America proudly ranked among the foremost nations of the earth in commerce bearers.

Fig. 3.—Shipways, With Material Storage and Assembling Space in Foreground

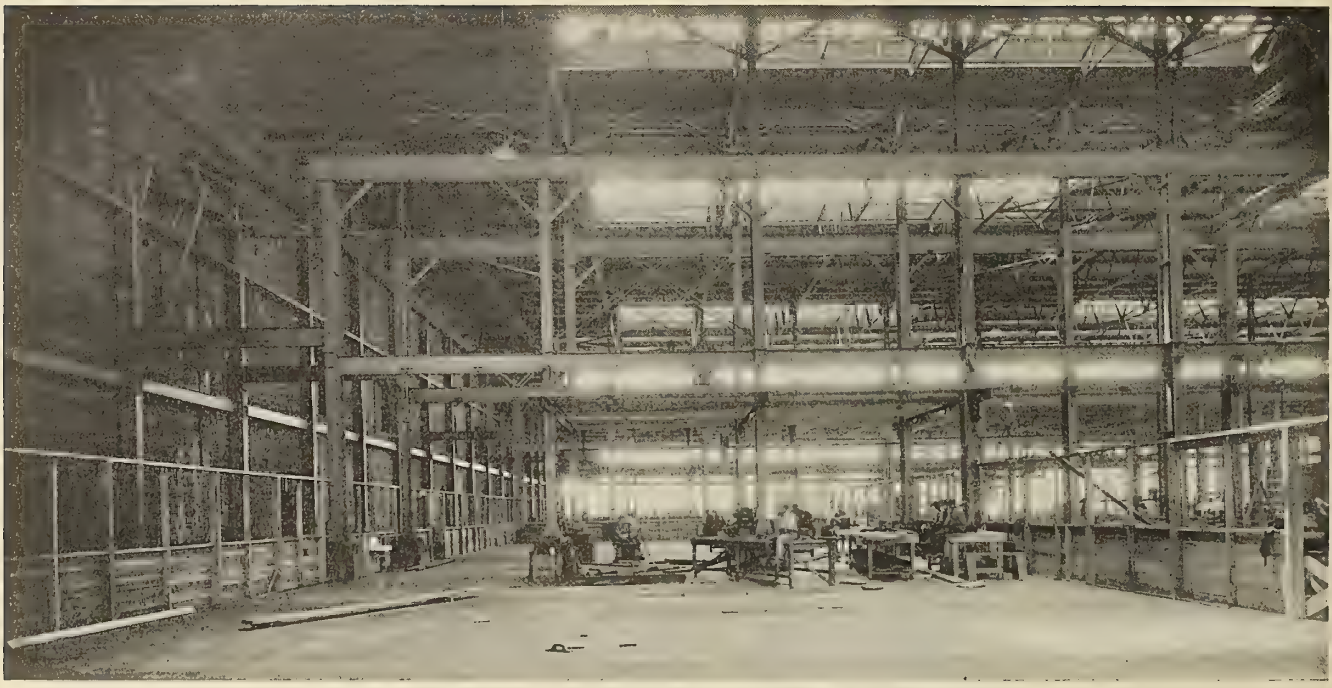


Fig. 4.—Interior of Shop Building, Showing Type of Construction

In earlier days, Portsmouth was a rival of Salem and other New England coast cities in their quest for trade, and many landmarks remain of days when the toilers of the seas made up the greater portion of our substantial population along the Atlantic coast. Under these circumstances it was but natural for Portsmouth again to come to the fore when shipbuilding assumed such important proportions in the attempt of the "great generals of industry" to meet the war emergency.

Shops and Office Buildings

The permanent structures used for manufacturing purposes at the yard are of substantial mill construction well located and easily adapted to the requirements of shipbuilding. The buildings under roof contain approximately 483,000 square feet of floor space, 413,000 square feet of which is now being utilized, and plans have been formulated requiring additions to the machine shop and foundries. The location of the main office building interfered with the placement of shipways Nos. 4 and 5, necessitating its removal intact to a position two hundred yards west and directly in front of the manufacturing buildings.

The yard has five shipways, each capable of accommodating a vessel 450 feet in length, but which can be ex-

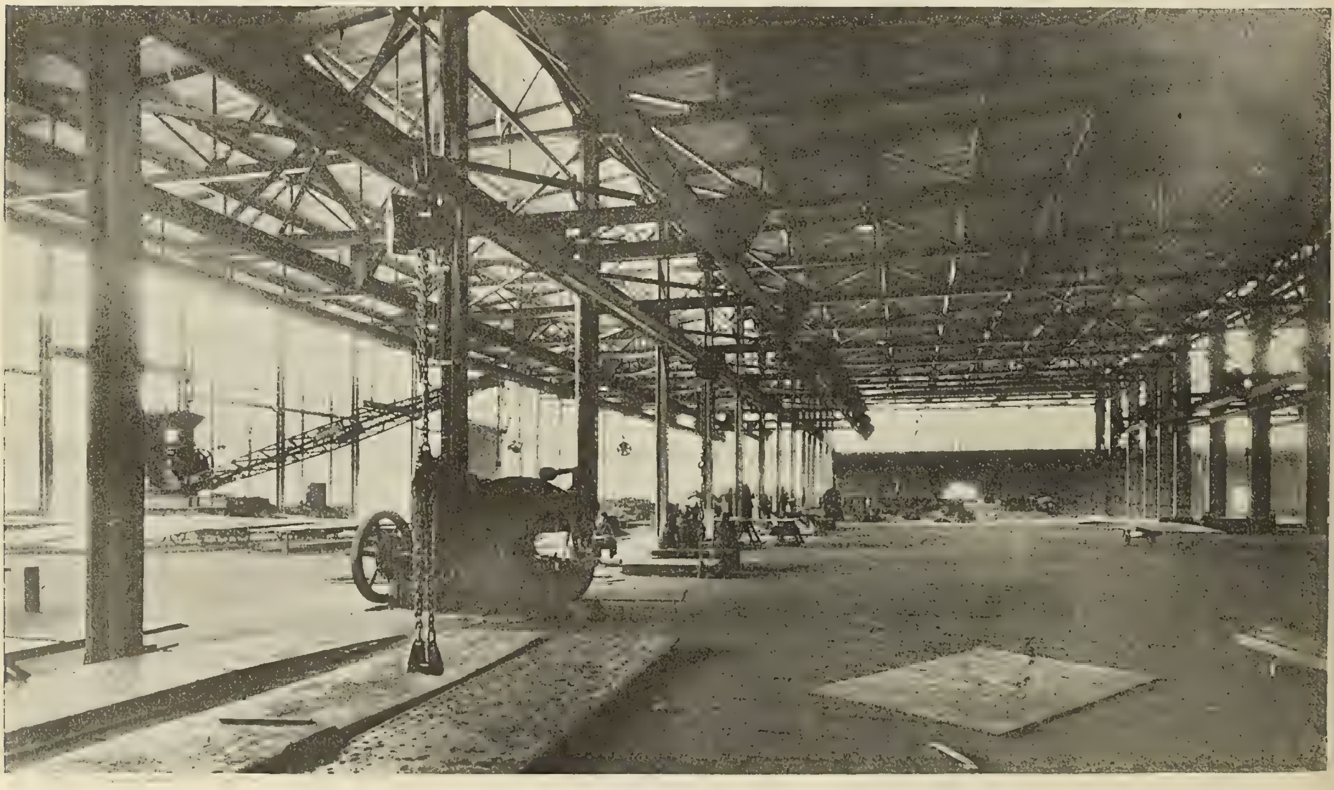


Fig. 5.—Partially Finished Plate Shop

Fig. 6.—Vessels Under Construction on Shipways

Fig. 7.—View of Shipway, Showing Portable Tower Cranes for Handling Material

Fig. 8.—Vessel Being Completed at Fitting-Out Berth

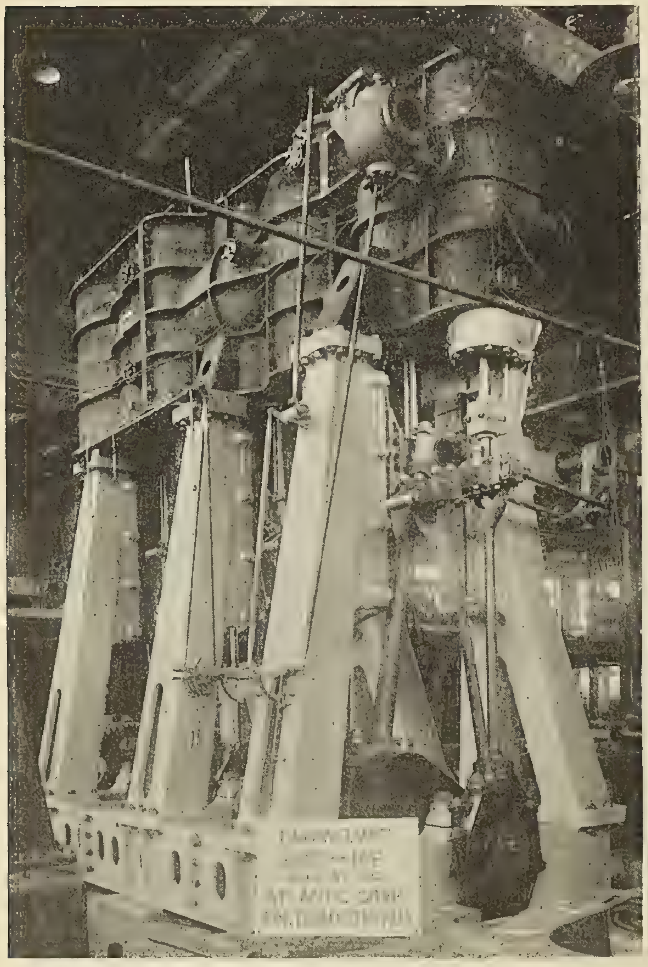


Fig. 9.—Type of Engine Built by Atlantic Corporation

tended to take a 600-foot ship. The shipways consist of central keel blocks resting on piling, while the launching ways are laid on concrete blocks and piling.

The gantry ways, used for serving materials of construction, rest on piling and are each equipped with two electric boom revolving tower cranes. Brownhoist & Browning locomotive cranes are used in handling the materials in the yard. A transfer table at the end of the ways permits the shifting of the gantry cranes from one way to another. The excavation for the ways was begun in February, 1918, and the first keel was laid on May 23, 1918.

The river in front of the ways has an average width of 500 yards and a depth at mean low tide of from sixty to seventy-five feet. The banks drop off abruptly at the end of the launching ways to a depth of over thirty-five feet. The river empties into the Atlantic Ocean two miles east of the plant and the depth of water throughout this distance ranges from forty-seven to one hundred feet.

Plate Shop

The ship shed, which covers an area of 141,000 square feet, contains the plate and angle furnaces, bending slabs, hydraulic presses, hammers, forges, shears, planers, bending rolls, punches, joggling presses, etc. There is also ample space for the assembly of frames, brackets, smokestacks, spars, masts, small bulkheads, shaft stool, etc.

The plate racks for storing incoming materials are located at the west side of the ship shed. Four rows of racks are arranged to receive plates on edge. The cars are run in on spurs from the Boston & Maine Railroad, each spur serving two rows of racks. The plates are brought into the ship shed on cars to the laying-out tables, from which point they move in the proper sequence of operations, progressing toward the east side. Two over-

head Northern Engineering electric traveling cranes of ten tons capacity, a small locomotive crane, numerous jib cranes fastened to the building columns, several electric trucks and platform trucks are used in handling the material within the ship shed, three sides of which, in addition to a portion of the roof, are of glass, thus giving full use of natural illumination.

A standard gage track enters the southwest corner of the ship shed and passes through the building to the southeast corner for the delivery of materials to the hulls, spur tracks radiating to each ship gantry way and outfitting dock.

Larger bulkheads, shaft tunnels and fantails are assembled in the yard near the shipways. Fabricated material in small allotments can be stored at the head of the ways.

The machine shop is particularly well equipped with cranes and machine tools suited to the manufacture of medium-sized marine engines. Triple-expansion engines of 2,800 horsepower are to be used in the present vessels.

Power Plant

All machine tools and other equipment are either electrically or pneumatically operated, the power being generated in a central power plant of 1,060 kilowatts capacity made up of the following machines:

One 500-kilowatt, 600-volt, 3-phase alternating current Curtis generating set.

One 400-kilowatt, 220-volt direct current General Electric generator, Corliss engine-driven.

One 100-kilowatt, 220-volt, direct current Sturtevant vertical engine-driven.

One 60-kilowatt, 600-volt, 3-phase alternating current generator direct connected to Sturtevant high-speed horizontal engine.

The turbine is supplied with the necessary condensing apparatus.

The boiler house is equipped with four 500-horsepower Babcock & Wilcox boilers fired with Rielly stokers; also modern fuel- and ash-handling apparatus.

The ground floor of building No. 2 contains the general stores, electrical department, pneumatic tool room; second floor, the joiner shop, riggers' loft, division of mold loft, and a restaurant with a seating capacity for four hundred, and the third floor contains the ship stores, engine and hull drafting rooms, blue printing and main mold loft with a free area of 29,000 square feet.

Training of Workmen

Special attention has been given to educational development; training of unskilled men for riveters, chippers and calkers, holders-on, heaters, etc., following the plan used by the Westinghouse companies through the use of skilled mechanics as instructors. Many of these men have had the advantages afforded by the training center established through the efforts of the training department of the Emergency Fleet Corporation.

Fig. 10.—Main Office Building

Skilled and unskilled men are sent through the training department by the employment department, assignments of skilled men being made to the various departments after they have been tried out by the training department. The unskilled men are kept under instruction for a sufficient time to enable them to do the work of the particular craft for which they have been engaged, re-classification being made according to the schedule laid down by the Shipbuilding Labor Adjustment Board.

This training is carried through in connection with the construction of one hull, which is devoted almost exclusively to this work. New employees, old employees transferred to new crafts, and unskilled men who have been under training are followed up through weekly investigations by the employment department for a period sufficient to learn their capabilities for the work. Those unable to qualify after a reasonable time are either reclassified, changed to more suitable work or discharged.

Classes in blue print reading and ship terms are available three evenings per week from 6:45 till 9 o'clock in the Portsmouth High School building.

It is the purpose of the management to institute a more comprehensive course of training covering apprenticeships in the various crafts; also special courses for the development of foremen, leading men and skilled mechanics in the science of their trades, making a detailed study of the trade, the job and the man, and the executive qualities required to properly direct the work.

Fig. 11.—Beginning of Yard Construction

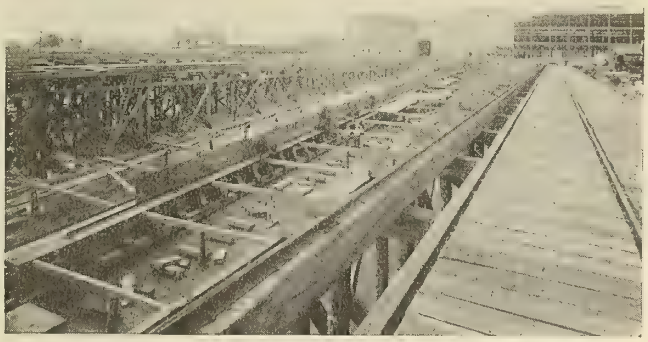


Fig. 12.—Way No. 1 Six Days After Laying of First Keel

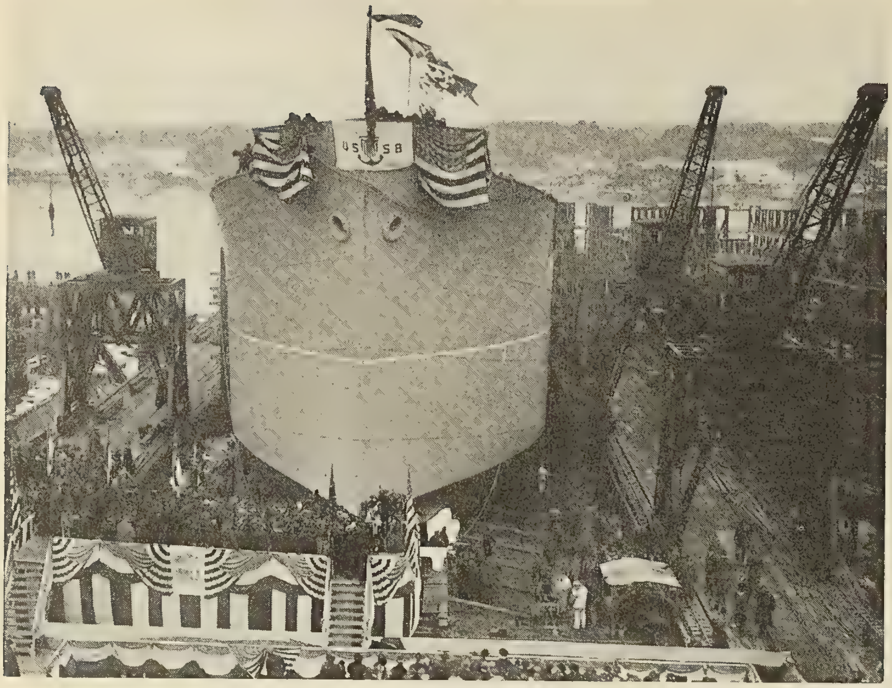


Fig. 13.—S. S. *Kisnop*, Launched January 18, 1919

Attention has been given to promote the best interests of the workers, and any venture that tends to improve their contentment is encouraged. There is a branch bank for the convenience of the workmen, the Employees' Reference Committee and a suggestion system.

Housing Facilities

The housing facilities of Portsmouth soon proved inadequate, a condition that assumed very serious aspects until the Emergency Fleet Corporation undertook the development of a housing plan in an adjacent property of approximately 60 acres, known as Atlantic Heights, where eight dormitories were erected, each containing forty-eight single rooms furnished complete. The buildings are steam heated and electrically lighted, screened windows, three showers and a tub bath on each floor, lavatories and a large living and writing room, and, in addition to the above, two hundred and seventy-six houses were erected, varying in size from four to six rooms, containing every modern improvement. These houses are of the best building construction.

The vessels being built are of the *Robert Dollar* type of 8,800 tons capacity, 427 feet in length, 54 feet beam and 24 feet depth. The first ship, the *Kisnop*, was launched 70 percent complete on January 18, 1919, eight months from the laying of the keel. This vessel was outfitted at the mooring dock at the south section of the yard and was ready for her trial trip on May 1.

The second vessel was launched May 3, 1919, 85 percent complete, and others are expected to follow in rapid succession. This compares favorably with the results obtained at similar yards where construction work was carried on contemporaneously with shipbuilding and the men had to be trained in the knowledge of the crafts applying to the art of modern ship construction.

Norway's Shipping Losses During the War

The Royal Norwegian Navigation Bureau has officially announced that Norway's loss at the end of 1918 comprised 629 steamships, aggregating 1,031,360 gross registered tons; 178 sailing vessels, aggregating 194,777 gross tons; 17 motor boats, aggregating 10,591 gross registered tons, and 5 barges, aggregating 3,327 gross registered tons, making a total of 829 vessels, aggregating 1,240,055 gross registered tons. The loss of human lives was 1,155.

At the outbreak of the war in 1914, Norway's registered merchant fleet comprised 3,405 vessels, aggregating 2,626,708 gross registered tons. The loss, therefore, calculated on a percentage basis, is 24.11 percent of the vessels and 47.08 percent of the tonnage. Norway's war loss is therefore without comparison the greatest of the Scandinavian countries. On January 1, 1919, 155 steamships and motor boats, aggregating approximately 94,000 tons, were under construction in Norway.

Fig. 14.—View of Dormitories, Atlantic Heights

Fig. 15.—Bird's-Eye View of Atlantic Heights

Fig. 1.—View of Waterfront at the Jacksonville Outfitting Yard, Showing Six Completed Vessels at the Dock

Quick and Efficient Machinery Installation by Jacksonville Plant

Records Made by Jacksonville Outfitting Yard in Fitting Out Emergency Fleet Vessels—War Plant to Be Continued as Repair Yard

BY E. T. HOLLINGSWORTH, JR.

REALIZING the absolute necessity of quick installation of machinery in the ships being constructed by yards of the South Atlantic for the Shipping Board in order to get the vessels ready for service, John Clarence Temple, of Newport News, Va., general manager of the Jacksonville Ship Outfitting Yard, Jacksonville, Fla., secured a contract to install the machinery in twenty 3,500-ton Ferris type hulls in February, 1918, and on April 15 (less than one month from the time work was commenced on the big plant in Jacksonville) a crew of skilled mechanics, the necessary buildings, appliances and accessories were in readiness for the arrival of the first hull.

As has been demonstrated during the war emergency, ship construction by unskilled labor is enough to try the patience of more patient men than those at the head of the big new industry. In those plants, however, wherein hulls have been built by unskilled labor in fairly good time, when it came to installing the machinery in the vessels, in many instances, the 3,500-ton ships, which required eight months to build, also required a like time to get ready for their sea trials.

In securing this contract, therefore, Mr. Temple, who had had considerable experience in similar work for the government, realized that, unless he could bring to his yard men who were experts in their respective trades, the deliveries of ships for service would be no farther advanced than if the builders themselves were doing the work. On August 29, however, when the first vessel sailed from the plant for her sea trial, the advisability of securing skilled workmen in machinery installation work was demonstrated

Record Is Made

From July 2 to November 12 the Jacksonville Ship Outfitting Yard installed the machinery in seven 3,500-ton Ferris type ships, and on this date, when the Shipping Board was calling for quick deliveries, the plant decided to go out after a record. On November 12, at noon, the steamship *Tyee,* built by the Morey & Thomas shipyard in Jacksonville, was towed to the docks of the Jacksonville Ship Outfitting Yard, and on November 26, exactly twelve and one-half working days from the time the vessel arrived at the plant, she stood her dock trial. This record has not been duplicated in the ship machinery installation annals of the United States, although several very close records have been announced, and clearly shows that, in addition to being skilled in their respective trades, the men must maintain at all times the utmost loyalty to their employer.

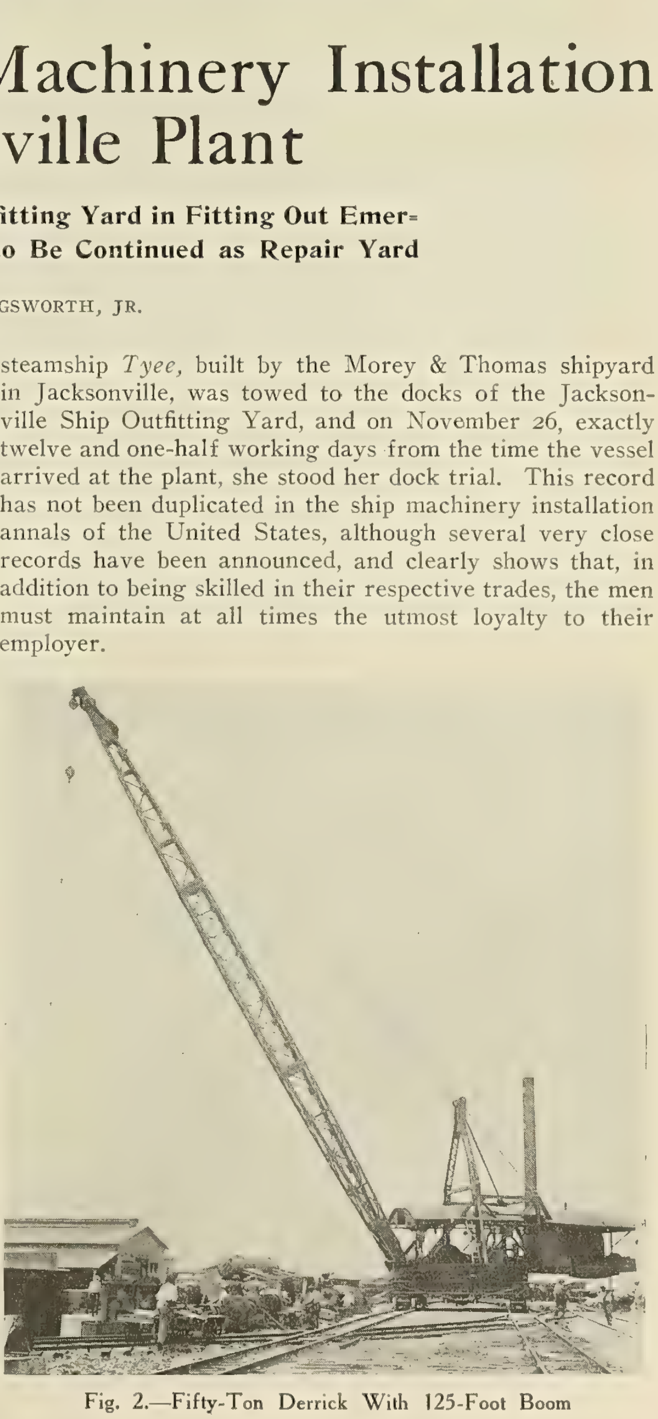


Fig. 2.—Fifty-Ton Derrick With 125-Foot Boom

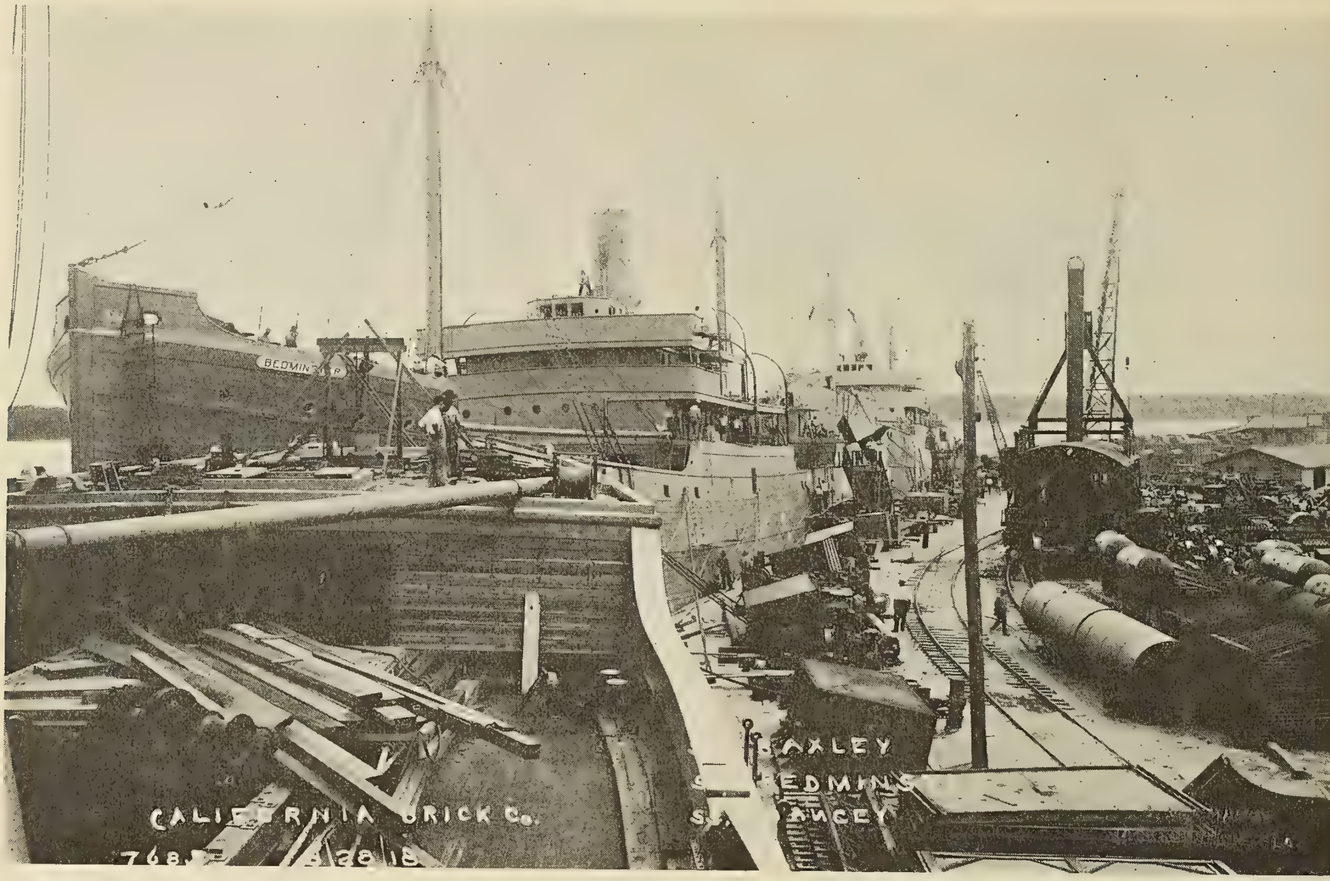


Fig. 3.—First Two Ships Completed at the Jacksonville Outfitting Yard

From July 2, 1918, to the present date, the Jacksonville Ship Outfitting Yard has completely outfitted fifteen Ferris-type hulls, and holds contracts for several additional vessels of this type, as well as contracts to install the machinery in two 7,500-ton concrete tankers being built by the A. Bentley & Sons shipyard in Jacksonville and two 3,500-ton concrete vessels being constructed by the Liberty Shipbuilding Company, Wilmington, N. C.

Work Is Systematized

Under the guidance of Superintendent J. V. Borum, work at the Jacksonville Ship Outfitting Yard has been systematized to the highest degree. When the peak load of ship machinery installation was reached last fall, just before the armistice was signed, this plant was employing approximately 700 men (skilled workmen at their particular trades), and never had there been the least labor trouble to mar the serenity of the plant.

In connection with the extreme loyalty shown by the men for the plant at all times, and the highly efficient work they have performed, Mr. Temple states that, after having made a study of working men in the aggregate, he has arrived at the conclusion that, in order to obtain the maximum results at minimum expense, it is necessary for the employer to show marked consideration for his employees' welfare. When the plans of the plant were first drawn they included a small hospital, adequate eating facilities and complete and up-to-date sanitary appliances. "The men realized our interest in their welfare," declared Mr. Temple, "and they felt that we looked upon them as a part of our organization, and not as mere inanimate pieces of machinery which could be replaced promptly if so desired."

According to men who have visited the plant from big shipbuilding yards of the East, the facilities for machinery installation in ships at the Jacksonville Ship Outfitting Yard are unsurpassed in the United States. The plant includes a blacksmith shop, machine shop and pipe shop capable of taking care of any repair work which might come to them. The waterfront is served by a locomotive crane with a capacity of fifteen tons and a traveling derrick with a capacity of fifty tons, the latter having a boom 125 feet long, making it possible to lift heavy machinery from ship to workshop, or from workshop across one ship and into the hold of anther moored alongside.

Another record made by the yard, which is worthy of mention, is the fact that during the nine months' history of the plant there has never been a serious accident. This last should be accredited to the efficiency of the safety organization and the alertness of the foremen.

The officials connected with the Jacksonville Ship Outfitting Yard include J. C. Temple, general manager; J. V. Borum, superintendent; O. E. Eriksen, general foreman, and N. H. Franks, purchasing agent.

The foremen of the various departments are: C. H. Blackburn, assistant general foreman; T. Eriksen, foreman outside machinist; J. R. Barker, foreman inside machinist; William Linder, foreman boiler maker; F. M. Rainey, foreman pipe fitter; R. H. Beazlie, foreman electrician, and J. Carraras, foreman ship carpenter.

To Continue Work

Although started primarily as a war industry to take care of the ships being constructed by the Shipping Board, the success of the Jacksonville Ship Outfitting Yard has been so marked that the concern has decided to continue the operation of its plant in the future and repair such vessels that might come to Jacksonville or the South Atlantic after the last hull contracted for by the Shipping Board is steaming her way to foreign ports.

The Follow-Up Department at Squantum

Special Department Organized at Squantum Plant of Bethlehem Shipbuilding Corporation, Ltd., to Eliminate Delays in Executing Rush Contracts

BY G. HOBART STEBBINS

IN the fall of 1917, after the new Squantum works of the Bethlehem Shipbuilding Corporation, Ltd., had been authorized, the officials of the old Fore River plant were confronted with the proposition of building up a new organization of seven thousand men. The Squantum yard was to specialize upon destroyers, and the Navy Department was placing every possible emphasis upon the necessity for building these vessels quickly and in quantity In the organization of the new yard, the old Fore River plant gave every possible aid, but with its own rapid expansion it had difficulties enough of its own. Materials for the construction of the destroyers were coming from

PLAN OF ORGANIZATION ESTABLISHED AT SQUANTUM

General Superintendent

Superintendent

Office Supt.	Foreman—Fabricating Shop	Follow-up Man Hull
Material and Purchasing Agent	Foreman—Fitting-Erecting	Follow-up Man Pipe Shop
Chief Piece Work	Foreman—Riveting-Calking	Follow-up Man Electricians
Works Accountant	Foreman—Pipe Shop and Fitting	Follow-up Man Sheet Metal
Timekeeper	Foreman—Electricians	Follow-up Man Carpenters Riggers
Paymaster	Foreman—Sheet Metal Shop	Follow-up Man Erect. Machinist
Plant Engineer	Foreman—Carpenters	Follow-up Man Machine Shop
Service Dept.	Foreman—Riggers	Follow-up Man Store
	Foreman—Erecting Machinist	Follow-up Man Plans
	Foreman—Machine Shop	
	Foreman—Storehouse	
	Foreman—Paint Shop	
	Foreman—Yard Department	
	Foreman—Welding	
	Foreman—Transportation	
	Foreman—Tool Room	
	Trial Engineer	

all parts of the country, and at a time when freight congestion was at its worst. These conditions, together with the impossibility of getting experienced shipbuilders, made the proposition a difficult one.

The first step in building up a new organization was the appointment, by the manager of the Fore River plant, of the new superintendent. The company was very fortunate indeed in having for this position a man of exceptional caliber and one thoroughly schooled in shipbuilding. Upon the new general superintendent fell the burden of organizing Squantum, although the officials of the parent plant gave every possible co-operation. The next move in organizing the Squantum works was the selection by the general superintendent of his superintendent. The two men worked out further details of organization together. The plan of organization was first thought out thoroughly, and then each department head was selected from the material available. The foremen were picked one by one, as also were the heads of the office departments.

In addition to this there was built up a special department called the "follow-up department." This consisted of seven independent departments, each corresponding to one or more of the yard departments, and each responsible directly to the superintendent. In contrast to the foremen, who were practically all experienced men, well seasoned in their respective trades, the follow-up men were young men, picked rather for their training and initiative than for their familiarity with destroyers. Some of them had already had good shipbuilding experience, while others were entirely new to this work. They were all hired weeks before their actual work was under way, in order that they might have time to get acquainted with their work.

The plan of organization established at the Squantum works is shown below:

The duties of the newly organized follow-up department were as follows:

1. To schedule all work for the corresponding production department.
2. To record work done and submit to the superintendent a progress report each week.
3. To keep corresponding production department informed on their work holding up the department.
4. To keep other follow-up men informed on their work holding up the department.
5. To be responsible for the delivery of all necessary materials and products bought from outside the plant.
6. To provide all materials and products found necessary, but which were not covered by outside order.
7. To take up with the drawing room all matters of changes and delays in drawings and bills of material.
8. To take up with the government inspectors matters relating to inspection of material and proposed changes in construction.
9. To perform other work of technical, engineering or clerical nature that circumstances might bring up.

The first use made of the follow-up department was to get out schedules of all work to be done in each department. These schedules were based on a master schedule giving laying of keel, launching and delivery of each ves-

sel. The master schedule itself gave the earliest dates that the leaders of the corporation thought possible. In making up schedules, the follow-up men were in constant consultation with one another because every department was so closely connected with each of the others.

For an example of the method of procedure, take the scheduling of the spring bearings. The outside machinists need these in place soon after a boat is launched in order to proceed with the installation of the line shafts and reduction gears. This, then, gives the structural department the date upon which the spring bearing foundations must be completed. The plate and angle shop must get out the plates and shapes early enough to give the structural department time for erection and riveting. The machine shop must deliver the spring bearings to the outside machinists at launching. This means that the shop must machine the brasses and send them to the pipe shop to have the cooling coils brazed in. The brasses then come back to the machine shop to be finished-machined and assembled. The assembly calls for a brass cover, which must be made up by the sheet metal shop. Each of these departments therefore must arrange its schedule accordingly in order that the installation of machinery can proceed without delay.

The progress report turned in to the superintendent was based on a comparison between the percentage of time gone according to schedule and the percentage of work done. From this one could readily see what jobs were lagging and investigate to determine the cause of delay. In every case where one department was held up by unfinished work of a second department, it was the duty of the respective follow-up men to get together with the foremen and eliminate the hold-up.

Not only was the schedule designed to help the foreman in laying out his work, but it also was intended to tell the follow-up man when materials on outside order were needed. By following the schedule, the follow-up man was able to bring pressure upon those items which were most urgent. Actual dealings with outside concerns were conducted through the material department, but this did not relieve the follow-up department from responsibility.

Due to the unavoidable speed required in ordering materials and products for the emergency contract, many items were necessarily overlooked. When such instances were brought to the attention of the follow-up men, it was part of their work to get them ordered both for immediate needs and in quantity for the entire contract. It also frequently happened that, although items were on order, delivery could not be obtained in time for the first vessels. Here the follow-up man had to find a way out of the difficulty, either by using some allowable substitute, by borrowing from the old plant at Quincy, or by locating it in the local market.

The follow-up men found another important function in getting drawings and bills of material corrected. The contract covers the first destroyers of the type to be built, and many alterations and additions had to be undertaken on the first vessels. The follow-up men, in many cases, collected the necessary data for these changes themselves. When this was impractical, they kept in close touch with the drawing room until the desired corrections were made.

As mentioned above, many times it was found necessary to make substitution both in materials and methods of construction. All such matters had to be taken up with local government inspector, and the follow-up department was the logical means of doing this. In fact, whenever practical, all matters relating to government inspection were conducted through the follow-up department.

In addition to the seven original follow-up men, two others were later added whose duties were of a slightly different nature. The plan follow-up man was made responsible for the issuing of all drawings and bills of material and the taking up of matters relating to them with the drawing room for the follow-up men. The plan follow-up man was also the Squantum representative to the old Quincy plant. All inter-plant business was conducted through him. This was a very important function, since the drawing rooms, order department, purchasing department, brass foundry, blacksmith shop and other important departments are located at the old yard.

There remains the store follow-up man, whose duty it was properly to order all warehouse stock needed on the job. All special items required in the construction of the

Follow-Up Department as Now Established at Squantum Plant

General Superintendent

Superintendent

- Assistant to Superintendent Hull Before Launching
  - [Foreman — Fitting-Erecting]
  - [Foreman — Testing-Calking]
  - [Foreman—Riveting]
  - [Foreman—Welding]
  - [Foreman—Fabricating Shop]
  - [Foreman—Carpenters]
- Assistant to Superintendent Hull After Launching
  - [Foreman—Pipe Shop]
  - [Foreman — Electricians]
  - [Foreman—Sheet Metal]
  - [Foreman—Erecting Machinist]
  - [Foreman—Machine Shop]
  - [Foreman—Riggers]
  - [Foreman — Painters]
- Assistant to Superintendent Engineering Division
  - [Foreman—Storehouse]
  - [Foreman—Yard Department]
  - [Foreman—Transportation]
  - [Foreman—Tool Room]
  - [Trial Engineer]
  - [Technical Department]
  - [Office Superintendent]
  - [Material and Purchasing Agent]
  - [Chief Piece Work]
  - [Timekeeper]
  - [Paymaster]
  - [Plant Engineer]
  - [Service Department]
  - [Works Accountant]

vessels, such as castings, valves and auxiliary machinery, were ordered by the order department at the old plant. In addition, there was a large order put through for general warehouse stock, to be used as occasion required. When material was found necessary which was apparently not covered by the warehouse stock, the store follow-up man, in conjunction with the other follow-up man, investigated the item in question. It was his duty to see that material was not duplicated, that the proper quantities were ordered, and that the proper specifications were given.

The value of the follow-up department manifested itself in innumerable ways. The hull follow-up man, for instance, developed with his foremen an entire system of operation for the structural departments. This comprised the marking and storing of raw material, the system for following each piece through the fabricating shop, and the method of assembly and erection.

The pipe follow-up man developed a manufacturing sheet detailing each pipe and tabulating its material, length, bore, gage, flange specifications and the pieces immediately adjoining each end. This was of great value at the beginning of the job in breaking in green men. The follow-up man for the electrical department made up his own bills of material, collecting data here and there wherever they were obtainable.

It was found that the machine shop could not begin to turn out the required amount of machine work. The follow-up man made an analysis of conditions and the machine work was finally distributed at his discretion among three additional shops. The store follow-up man has saved the corporation much money by his careful analysis of the stock situation.

As the work progressed at the Squantum works and the vessels began to be launched, the superintendent found that his duties were assuming too large proportions for him to handle alone. Also the night force was beginning to number several hundred men. The important function of the follow-up men had been to aid in getting the first impetus into the organization, and, as it became organized to operate in a routine manner, the work of the follow-up men diminished; consequently, they were withdrawn one by one to build up the supervising force.

The two follow-up men on hull work were made assistants to the superintendent, in charge of hull construction. One is responsible for the construction up to and including launching, while the other takes the vessels when they enter the water and follows the construction through delivery. The follow-up man for the pipe shop was made assistant to the superintendent, in charge of engineering. The plan follow-up man was made night superintendent in charge of hull construction, and the follow-up man for the erecting machinists was put on engineering night work. The follow-up men for the sheet metal department and the machine shop were transferred to further bolster up the engineering division.

The positions vacated by these promotions were filled by the assistant follow-up men who had been receiving good training in that capacity. They continued to carry on the work of the respective departments as before. But, as the material situation began to straighten out more and more, the work became gradually less. Most of the difficulties of the follow-up department were overcome in delivering the first vessel, after which the work became largely a matter of duplication.

At this point, when the work of the follow-up department did not warrant the maintenance of seven independent departments, they were combined in one. This department, known as the "technical department," carries on the same work but is a more compact organization.

Steel Boilers and the Board of Trade

The Board of Trade's rules for the construction of steel boilers are being considered with the view to certain amendments being made; but, as the details are not yet ready for publication, and as the construction of a large number of boilers under the Board's survey is probable in the near future, a brief statement of the approximate changes which will result has been issued for the information of the surveyors, engineering firms, boiler makers and users interested therein.

It should be understood that the amendments apply only to boilers made of steel manufactured by firms in the Board's list in Section 108 of the Instructions as to the Survey of Passenger Steamships, the boilers being open for inspection during construction, the workmanship of the highest class as required for the lowest factor of safety, and the Board's existing rules complied with in all respects except as amended below. The following data are embodied in the statement referred to:

CYLINDRICAL SHELLS

$$\frac{s \times (t - 2) \times J}{2.8 \times D} = \text{working pressure,}$$

where s = minimum tensile strength of plates in cylindrical shell, in tons per square inch.
t = thickness of shell plates in thirty-seconds of an inch.
J = smallest calculated percentage strength of longitudinal joint, as determined by ascertaining (1) the plate percentage strength, (2) the rivet percentage strength, and (3) the combined plate and rivet percentage strength.
D = inside diameter, in inches, of the shell plates in the strake considered.

The maximum pitch of the rivets may be increased to 12¼ inches. In other respects the riveting should be in accordance with the Board's existing rules.

BUTT STRAPS

To be in accordance with the existing rules, excepting that, in every case, ⅛ inch is to be added to the thickness of the inside strap.

FLAT PLATES

The pressures allowed by the Board's rules, using the constants and formula in the printed instructions, may be modified as follows:

Constant 240.—On end plates up to and including ¾ inch in thickness, the pressure obtained by the present rules should stand. On end plates 1¼ inches thick, the pressure allowed may be increased by 10 percent. For plates of intermediate thickness a proportionate increase of pressure may be allowed.

Constant 210.—As with constant 240.

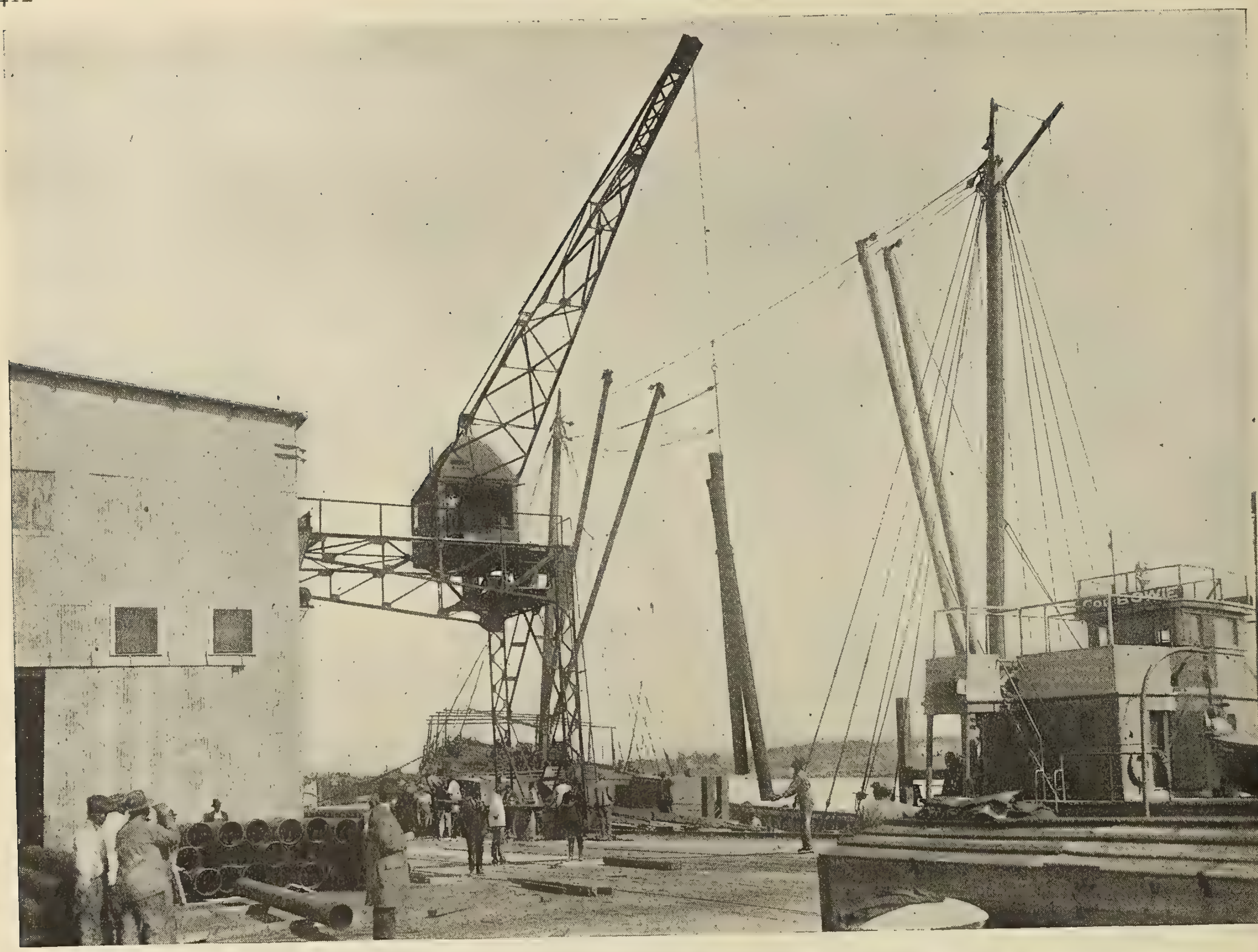
Constant 165.—As with constant 240, but substituting ⅞ inch and 1⅜ inch respectively for the thickness mentioned as allowable for constant 240.

Constant 150.—As with constant 240, but substituting ⅞ inch and 1⅜ inches respectively for the thickness menmentioned as allowable for constant 240.

Constant 100.—Pressures allowed on combustion chamber plates supported by nutted stays are to be calculated by the present rules.

Constant 66.—Pressures allowed on combustion chamber plates supported by riveted stays to be calculated by the present rules for plates up to and including ½ inch in thickness. For plates 11/16 inch thick, the pressures allowed may be increased by 6 percent.

For plates of intermediate thickness, a proportionate increase of pressure may be allowed.



Transferring Long Water Pipes Between Vessels and Shore at the Beaumont, Tex., Marine Terminal by Means of the Traveling Gantry Jib Crane

Tube Plates

In accordance with the Board's existing rules for the present.

Combustion Chamber Stays

In accordance with the present rules.

Steel Longitudinal Stays

Stays having threads screwed not coarser than six per inch:

$$\frac{(D - 0.34)^2 \times 9{,}500}{\text{area supported}} \times \frac{s}{28} = \text{working pressure,}$$

where D = diameter of the stay over the threads in inches.
s = minimum tensile strength limit of stay, which should not exceed 28 tons per square inch.

The maximum stress per square inch allowed is not, however, to exceed 10,600 pounds for steel stays of 27 tons, and 11,000 pounds for steel stays of 28 tons tensile strength per square inch.

In cases where the ends are enlarged and the body of the stay is smaller in diameter than at the bottom of the threads the rule will be:

$$\frac{(d - 0.125)^2 \times 9{,}500}{\text{area supported}} \times \frac{s}{28} = \text{working pressure,}$$

where d = smallest diameter of the stay, in inches.
s = minimum tensile strength limit of stay, which should not exceed 28 tons per square inch.

The above is conditional on the longitudinal stays of double-ended boilers being efficiently supported at the mid-length position.

Stay Tubes

For iron stay tubes as at present used, without the material having been tested in the Surveyor's presence, a stress of 7,000 pounds per square inch on the net section may be allowed.

Furnaces

The working pressure which may be allowed on corrugated furnaces should be ascertained by the following formula:

$$\frac{c \times (t - 1)}{D} = \text{working pressure,}$$

where D = external diameter at the bottom of the corrugation or camber, in inches.
t = thickness at the bottom of the corrugation or camber, in thirty-seconds of an inch.
c = 480 for furnaces of the Fox, Morison or Deighton section, and 510 for furnaces of the bulb section made by the Leeds Forge Company.

Hydraulic Test

For boilers whose working pressure (W. P.) does not exceed 100 pounds per square inch:

W. P. $\times$ 2 = hydraulic test pressure in pounds per square inch.

For boilers whose working pressure exceeds 100 pounds, but does not exceed 200 pounds per square inch:

W. P. $\times$ 1½ + 50 = hydraulic test pressure in pounds per square inch.

For boilers whose working pressure exceeds 200 pounds per square inch:

Handling Barrels of Asphalt Along the Terminal Shed at Beaumont, Texas, Including Counting, Distributing and Tiering

W. P. × 1¾ = hydraulic test pressure in pounds per square inch.

The foregoing brief statement is issued at the present time in order that makers and users of boilers may take immediate advantage of the amendments contemplated in the rules now under consideration.

Boiler designs should be submitted as early as possible, in order that any necessary amendments may be made before the material is ordered.

Operating Crane Costs in the United States

BY H. MCL. HARDING*

WHILE there are many figures giving the costs of operation of traveling gantry jib cranes in Europe and South America, yet it is important to have these costs for cranes now being operated in the United States under the present prices for electricity and labor.

It is also necessary to know what is the charge to the shipper or consignee by the municipality, which should not only be the operating costs of the cranes with the expenses of maintenance, interest and amortization, but also include any profits for the use of the cranes added and for ready comparison should be reduced to a common tonnage basis.

The following letter of March 6, 1919, gives most completely this information. The city of Beaumont, Tex., charged the shipper four and four-tenth (4.4) cents per ton for cranage, as expressed in the letter:

"On this date we handled the following amount of freight, from ship to pier: 2,103 barrels of asphalt, lift 40 feet, swing 50 feet, in eight hours and thirty minutes, at a cost to shippers of $25.16 for use of gantry cranes, or 1,051,500 pounds of freight at a cost of $.002 per pound, or 4⅛ barrels asphalt per minute at a cost of $.012 per barrel.

"(Signed) O. S. HUNTER,
Beaumont, Texas. "Harbor Master."

* Consulting marine terminal engineer, New York.

American Cargo Handling Equipment Used at French Ports

SOON after the declaration of war by the United States Government, American engineers formulated plans for handling the coal and food products which would be necessary to sustain an army of over 2,000,000 men, many thousands of miles from its base. American cargo-handling machinery followed in the train of American engineers. It is safe to say that practically every French port is equipped with a number of American-made cranes.

At the two American ports from which supplies were forwarded to the United States forces, Brownhoist locomotive cranes of the gantry type are installed. Other makes of cranes of the same type are also in use here. At St. Nazaire, four standard 8-wheel Brownhoist locomotive cranes and as many standard 4-wheel locomotive cranes are in use on the dock for handling miscellaneous cargo. The type of 4-wheel crane used in this installation is shown in Fig. 2. The cranes in this picture, however, are shown in use on the River Seine, between Rouen and Paris. Four raised pier cranes are installed on one of the quays at Brest for unloading miscellaneous cargoes and grain, and six of the same type have been installed on another quay. These cranes were also used at this port for handling army supplies. Cargoes were unloaded

Fig. 1.—Government Coal Storage Yard at Bonneinl-sur-Marne, Where Twenty Brownhoist Cranes Are Installed

faster than they could be taken away from the wharves at these ports by four railroad trucks and accessory motor trucks.

As cargo freight and coal were handled, however, in many parts of France, American cargo-handling machinery was installed from the extreme north to the far south. Starting at the north, we find the port of Dunkirque equipped with two Brownhoist 4-wheel cranes. At Havre, which is equipped with two of the Brownhoist raised pier cranes, as shown in Fig. 3, ten pontoon cranes and one 4-wheel crane are also in use. These pontoon cranes are being operated by the American Expeditionary Forces alongside the vessels for handling miscellaneous cargo. At Rouen, two large capacity pontoon cranes and seven 4-wheel cranes handle the coal which is being reloaded from barges to cars and stock piles. About twenty more Brownhoist standard locomotive cranes are located at the various small river ports between Rouen and Paris. In the outskirts of the French metropolis, six Brownhoist standard cranes are in use unloading miscellaneous material from the river barges.

At the Government coal storage yard at Bonneuil-sur-Marne, twenty-one of the Brownhoist standard locomotive cranes handle all the coal which is received in river barges and delivered to cars or placed in storage. Fifteen of the raised pier cranes are used in unloading the coal and grain at Cherbourg; five standard cranes are also used for the same purpose and for placing coal in storage at this port. At Roquefort, six of the raised pier cranes are used for cargo handling.

Moving along the coast to La Rochelle, two raised pier cranes are found unloading cargo, as well as two standard cranes which are used for handling miscellaneous freight. In the south, Brownhoist raised pier cranes and some of the standard cranes are used on the River Gironde, around Bordeaux, at Bassens, at Cette, at St. Louis-du-Rhone, and at Marseilles.

Those who have seen the extensive cargo-handling machinery equipment in use abroad are insistent in their demands for the installation of similar efficient facilities throughout this country. It is pointed out that unless the wharves and docks serving ocean vessels and the warehouses along the inland waterways of America are equipped with modern machinery, we will be unable to compete with France and England in future trade development.

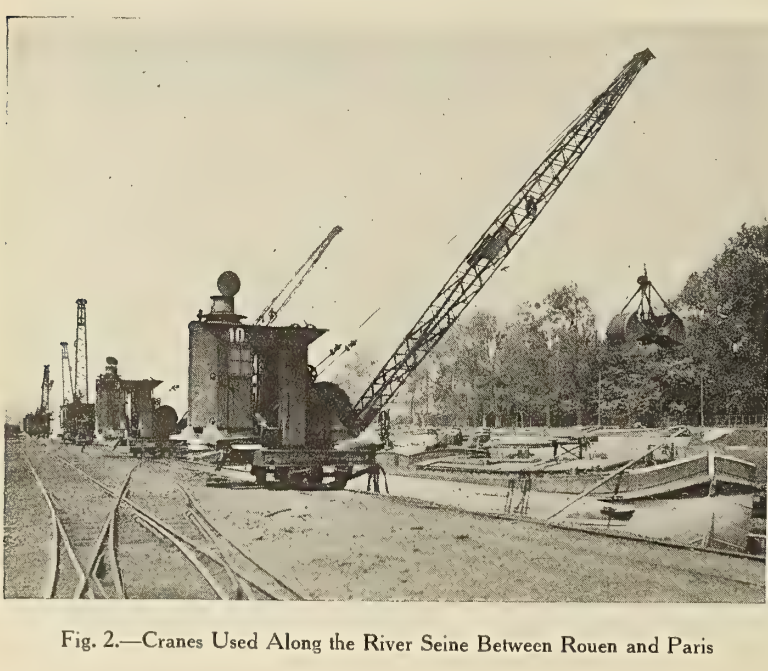


Fig. 2.—Cranes Used Along the River Seine Between Rouen and Paris

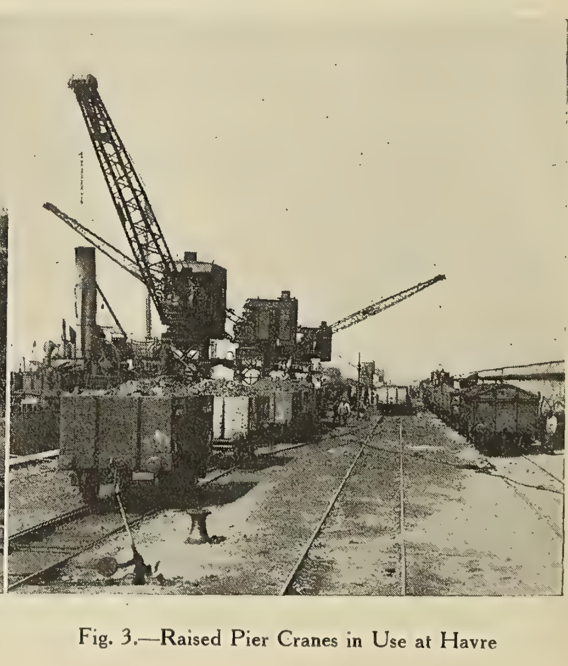
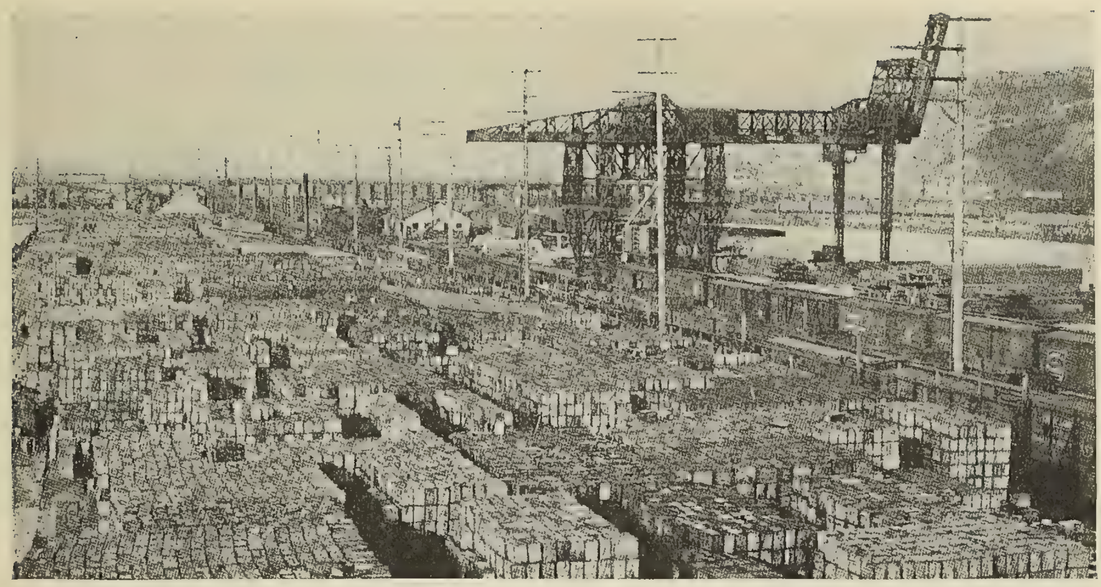


Fig. 3.—Raised Pier Cranes in Use at Havre



Four Million Cases of Saya Bean Oil Handled by Machinery at Seattle Marine Terminal

The Coming Mechanical Devices that Will Make Ship-Loading Economical*

Modernizing Port and Harbor Terminals—Crane Hoists—Overhead Tel= pher Systems—Electric Tractors and Trailers—Improved American Ports

THE entire question of building a great foreign trade for America contains no more important element than the problem of modernizing the port and harbor terminals by which our railroad systems and our ocean-going vessels are connected. In our war-time haste we concentrated on ships without giving enough attention to the equally important problem of providing adequate facilities by which cargo may be economically handled and without which we would not be in a position to compete with maritime nations that have been studying harbor and ship economies for decades.

Now that we have successfully met the tremendous emergency brought by the war, we are beginning to ascertain just what our status as a world trading and carrying nation really is. Whatever controversy may exist in connection with the future ownership of our merchant marine or the policy by which it is to be managed, all are agreed that our port and harbor facilities must be taken hold of in an energetic manner and brought up to the same standard of efficiency that characterizes most of America's typical industrial processes.

The spirit of optimism that pervades every recent discussion of port and harbor development is the best guarantee of what is to come. Before the United States had a merchant marine of its own it was a difficult matter to arouse public interest in port problems. Now that the vital connection between a successful future for our merchant ships, our export trade and our loading and unloading facilities has been recognized, the best engineering and mechanical brains in the country have set to work to devise appliances by which the United States, with wage scales nearly double those of its overseas competitors, may still win out through the medium of increased efficiency per man and per machine.

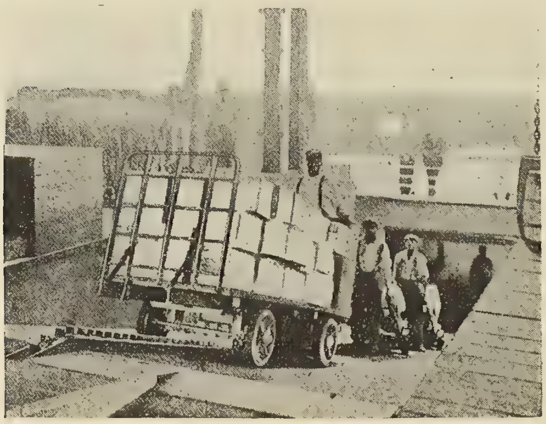
The concrete results of the efforts made up to this time to improve our ports are already beginning to assert themselves. On the Pacific, Gulf and Atlantic coast, cities with foreign trade aspirations are studying what may best be done to cut transportation costs and to assure for ships a quick and economical turn-around. Machinery is beginning to make its appearance on docks and piers where the repeated efforts of manufacturers in past years have met with no response. Everything now points to a development in the handling of general cargo, on which export trade depends to a high degree, that will put the ports of America as far ahead of its European competitors as they were formerly behind.

The difference which has always existed in the United States between the handling of general cargo and the handling of specialized cargo like coal, ore, oil and grain is very marked. No nation in the world has ever approached the record made by American ships in handling bulk cargoes. Our Great Lakes cargo carriers have made low-cost tonnage records that have been openly scouted and ridiculed abroad. These records were made possible by the wonderful loading and unloading devices which emptied ships in hours where the same number of days was once required for the job. Costs per ton have been reduced until ore can now be taken from Duluth or Superior to Conneaut, Ohio, or other ports adjacent to the Pittsburgh district for a lower charge than any other tonnage rates in the world.

The work which has now been undertaken by the port engineers and machinery makers of America is to duplicate this showing with boats built for carrying the miscellaneous cargo of which the bulk of export trade is made up. To devise a machine for loading coal is one thing; to devise apparatus that can handle pianos one minute and steel rails the next is a much more complex affair.

* From *The Americas*.

The methods formerly used for the direct operation of getting general cargo into merchant vessels in this country were a long way behind those of the most modern European ports. The amount of time lost, wages paid, dock charges incurred and other costs which were run up under the old system of loading ships by hand was bad enough in peace time, but under the necessities of war they became little less than criminal. It was clear that one of the most vital problems to be solved was that connected with the direct loading of ships. Probably the most ingenious invention for this purpose was the continuous elevator conveyor for packages of medium size and weight. This machine has developed an efficiency little less than marvelous. The limit to the service it will perform is only bounded by the ability of the workers at the receiving end to feed the moving belts and those at the delivery end to receive the packages and stow them quickly and safely away in hold or warehouse.



Combined Electric Truck and Lift

Careful accounts have been kept of the work of this sort of machine. It has been found that when workmen on the piers become accustomed to its use and learn how to adjust it, it can be got ready for operation within twenty minutes after the ship ties up to the wharf. Where gravity conveyors were used to assist in feeding and taking away from the main machine, speeds of 1,500 deliveries of miscellaneous packages, boxes, barrels and bags averaging in weight from 50 to 150 pounds were made per hour. This speed could be kept up for hours at a time, doubling at least the amount of work previously done in that time and reducing in a very marked manner the amount of breakage formerly chargeable to the old crane system for small packages. In this way incidental damage to shipments, which often ran into uncomfortably large sums, has been almost eliminated.

It is said that when operated in conjunction with modern crane hoists for the heavier freight the following advantages have been secured:

1. Speed of handling ship's cargo within its capacity can be increased from 25 to 75 percent.

2. The amount of labor required can be appreciably reduced.

3. Economy of electric current consumption is effected, most machines operating on 3-horsepower motors.

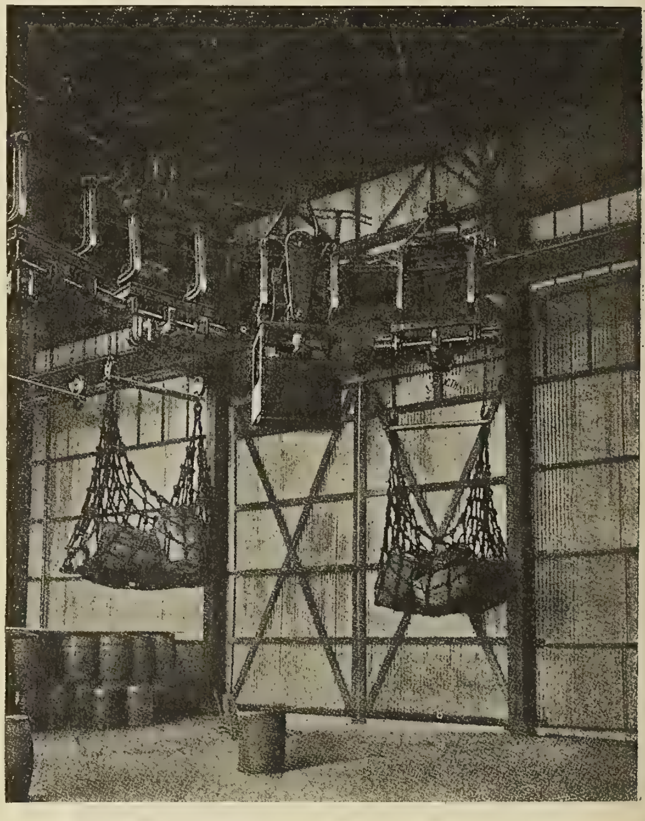
4. Damage to goods is practically eliminated.

It is interesting to see how one mechanical advance leads to another. The quick unloading of ships at first resulted in great congestion of freight at the end of the gang-planks, unloading machines and crane bases. Under the old hand-truck and hand-lifting method it was impracticable to stack freight higher than five feet from the ground. Stacking machines have now been perfected that stack freight three or four times as high as the old-style hand limit, thus trebling or quadrupling the amount of use that can be gotten from valuable warehouse or pier space.

Another modern freight-handling development is the overhead adjustable loop system. This system is particularly adapted to terminal sheds for the temporary storage of freight or materials before loading or after unloading from ships, barges or railroad cars. The primary purpose of this system is to speed up the movement of freight in the shed, to reduce the cost of handling it, to utilize the shed space to the greatest possible extent, both horizontally and vertically, and to relieve congestion at loading and unloading points.

This apparatus is doing a good deal to combat the inadequate equipment which formerly existed at nearly all marine terminals and which has caused ships to lose such a large percentage of their time in harbors. The time thus lost has recently been estimated by the United States Shipping Board to be 20 to 30 percent, during which the ship earns nothing and keeps other ships away from the dock. Naturally, the most important factor in reducing the amount of time spent by the ship in port is the devising of machinery capable of cutting down the number of operations required and increasing the speed with which goods can be moved.

The limiting factor in unloading ships is the speed with which the cargo handlers on the vessel can get the cargo out under the hatches and attached to the hook of the hoist or crane, or loaded on automatic conveyors. The same holds true when the process is reversed. To get such speed it is necessary to have machinery capable of being at all times able to take away the freight as fast as it is hoisted out of the ship. Such machinery is of various types, but the overhead conveyor has made some unusual records in this connection, especially in places where there is more than the usual amount of congestion and a conse-



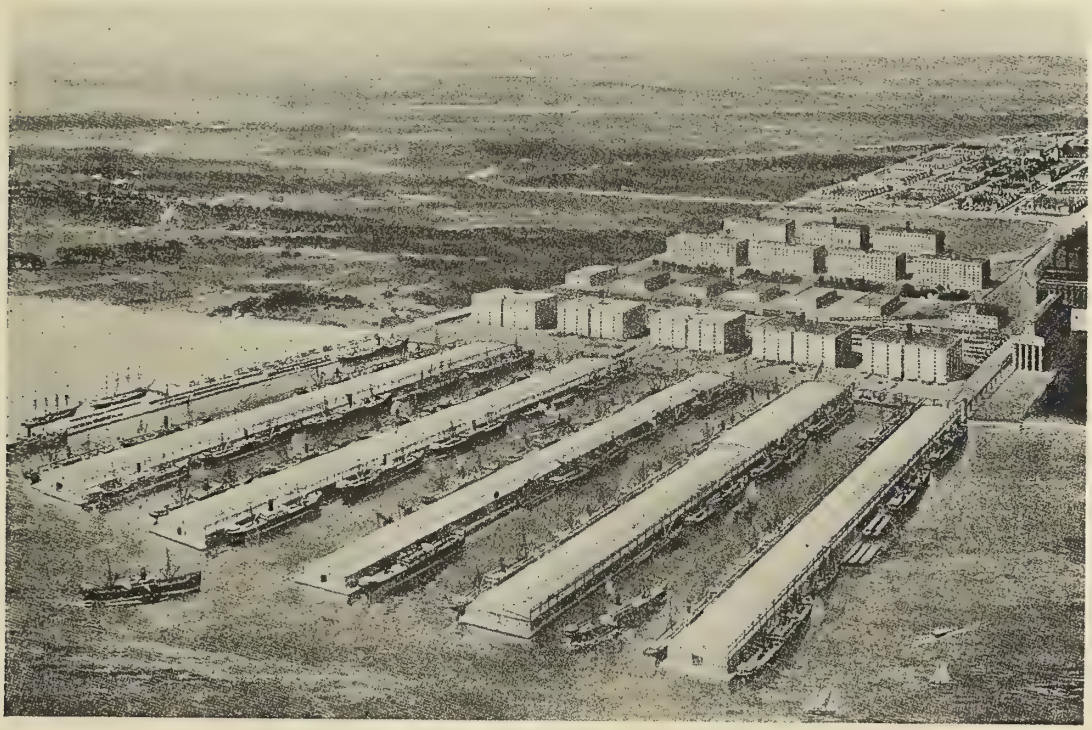
Special Electric Telpher for Pier and Warehouse Use

quent lack of warehouse space for the storage of freight.

Up to this time, few terminal sheds or warehouses have been fitted with overhead systems, but this device is now making rapid progress, due, largely, to the elasticity it introduces into the other handling devices. As a space saver it is unequalled, because it obviates the necessity for wide aisles for the passage of trucks. The overhead system tiers boxes, barrels, cases and bundles much higher than is feasible by any other means, thus multiplying the value of each square foot of warehouse or shed space.

At the ports where efficient mechanical equipment is already in operation, some remarkable records have been made. Beaumont, which has a port unit regarded by marine engineers as a model of what a port should be, is especially proud of some of the freight-handling work already accomplished at its docks. A recent record was that on March 6, 1919, when 2,103 barrels of asphalt were unloaded in eight and a half hours. The shipment moved at the rate of four and a half barrels per minute, and the total cost to the consignee for the unloading of the entire shipment, which weighed 1,051,500 pounds, was $25.16 (5/4/10).

In moving goods greater distances along piers or in warehouses than it is feasible to extend the conveying systems, the storage battery tractor and trailers have now largely come into use. With small tractors able to turn around in their own length, trucks heavily loaded are quickly hauled from one place to another, the whole apparatus being taken on huge freight elevators for removal from one level to another. One operator runs the whole contrivance, superseding a whole gang of stevedores with hand trucks propelled entirely by man power.

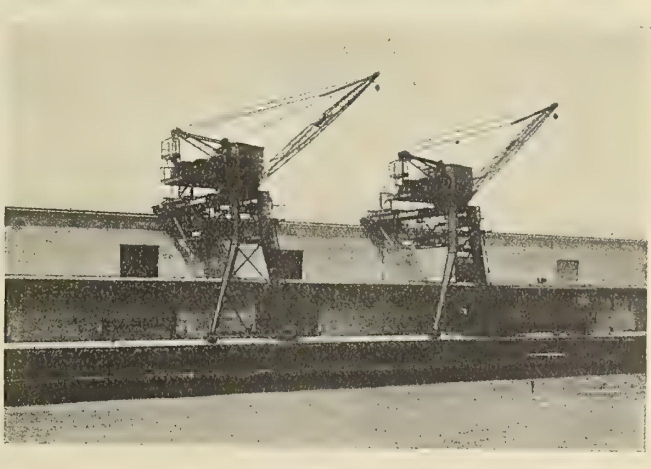


Municipal Terminal at Norfolk, Now Partially Completed

Some clever work has been done by the designers of cargo-handling machinery in making it adjustable to tide variations. Although the tide is not a very important factor in New York harbor, there are a number of American ports where it has to be given careful attention. This introduces the necessity for an amount of flexibility in all such machinery which no other designers have to provide.

The direct interest of the average exporter in this general question may be stated this way: "Will it be possible to operate the new American merchant marine so economically that, in spite of higher costs all around, rates can be made that will permit competition for American

Electric Tractors and Trailers in Use on Steamship Pier



Electric Crane Dock Equipment at Galveston

manufacturers in the markets of the world?" The answer, according to the men who are designing the American ports of tomorrow, and who are making the mechanical equipment with which they are to be operated, is "Yes."

There is no doubt that a most optimistic feeling concerning the future pervades the ranks of shipping and mechanical appliance experts. They are certain that the records made in handling coal, ore and oil are going to be repeated with general export cargoes. Labor costs of operating ships will be of small moment if the vessels can be mechanically unloaded, reloaded and coaled in a space of time even one-quarter less than in the ports of Europe.

Equipment of Docks and Warehouses

Equally important with mechanical equipment used in direct connection with the ship is the equipment of the dock and warehouse into or out of which the cargo must be handled. Modern practice in building docks differs radically from that of the past, with the gantry crane the unit around which all else seems to revolve. The crane has demonstrated itself to be the most economical, most flexible and quickest of all machinery used in connection with the handling of general cargo. When the United States was suddenly called upon to equip ports in France with machinery by which a potential army of four million American soldiers could be fed and munitioned, the gantry crane was the instrument chosen for the major share of the work. What can be done in modernizing every American port was vividly illustrated in France. Within a year from the letting of contracts for machinery, long lines of steamers were being unloaded at the army docks at Brest and St. Nazaire at a speed never before approached, allowing ships to get away for the return voyage in hours where in past years they would have required the same number of days.

While New York, through which passed last year 41 percent of the entire foreign commerce of the United States, is far behind in the matter of mechanical port equipment, it has potentialities in this respect far surpassing any other important port in the world. When the work of modernizing the port of New York is completed, freight will be handled at a speed and with an economy that will probably be beyond the reach of any other port. The first tentative work will soon start on the new Staten Island terminals and the construction of the proposed railroad tunnels to connect with them will be the nucleus for a land and water transportation machine capable of handling a fabulous amount of freight in a year.

Free Lighterage Abolished at New York

The abolition of the free lighterage system in New York harbor marked the beginning of the end of the old and costly régime. Railroads formerly furnished free lighterage to all parts of the harbor and included the cost in the line haul charge. The Federal Railroad Administration changed this and ordered separate charges to be made for lighterage service. This change has brought to the front the necessity of substituting direct rail connection for the outworn plans used in New York harbor ever since the days of sailing vessels.

At all American ports where the Railroad Administration has consolidated all railroad terminals in the interest of more economical freight handling, great savings have been effected. These savings have so far been much less at New York than at most other ports because the great barrier formed by the Hudson river between the two main parts of the port has made the continuation of flotation costs a necessity. Possible advantages of the port have thus been spoiled, but the rail tunnels that will inevitably be constructed will change present difficulties into advantages.

It used to be the fashion to point out Antwerp, Bremen, Hamburg and a few other European ports as examples of what a port ought to be. All the machinery used in these ports was made either in Germany or in England. It took the shock of a world war to show what American manufacturers of cargo-handling machinery could do, but they certainly rose to the emergency in splendid shape. The ports all over the world that have sought improved mechanical equipment during the past two years have in every case come to the United States for it. For instance, one American company making nothing but cranes has sold its equipment to the following French ports, to take one country alone: Rouen, Cherbourg, Brest, Dunkirk, Rochefort, Bordeaux, Nantes, Havre, Saint Nazaire, Saint Louis du Rhone, Cette, Marseilles and LaPallice.

Modernized American Ports

Of the American ports that have gone ahead and prepared to bid for their share of the nation's export trade by putting in mechanical equipment, comprehensive warehouse systems and economical rail connections, Galveston and Seattle are undoubtedly in the lead. Ships are now being cleared at Galveston faster than at any other port in the country. The Galveston Wharf Company, operating with the electric wharf cranes, is handling great quantities of cotton, sisal, steel billets, bagging, flour and other commodities and clearing ships in less than twenty-four hours. Seattle is making records closely approaching those at Galveston, although the character of freight handled by trans-Pacific vessels requires longer time for handling than is usually the case at the Gulf ports.

On the Atlantic coast, Norfolk is said by marine engineers to be pushing ahead the fastest. The channel depth at that city is something of a drawback until dredging now under way is completed, but the port itself, when completed, will be a model for the other aspiring seaports of the country.

By means of mechanical loading and unloading devices, a ton of ore is now carried from Duluth to Conneaut for half a dollar. The ships that do this make a profit in spite of the fact that they can only operate eight months in the year, while interest and other expenses run for the full twelve months. Who will believe that if our Great Lakes fleet, paying American wages to seamen, American prices for food and supplies and American salaries to officers, can be run at a profit, the same kind of skill cannot profitably be applied to the problems of ocean transit? Part of the answer is contained in the recent organization of the Association of Material Handling Machinery Manufacturers. Nearly all the important makers of mechanical loading apparatus have joined hands by means of this association for the purpose of putting at the service of American ports the very best technical skill that exists in their industry. The makers of the machinery know what wonders of economy and speed can be effected; all that now remains is to teach our exporters and civic authorities, and the job is done.

The daily papers are often much twisted in their accounts of mechanical happenings. Some years ago an oiler, while he was filling a crank bearing, was killed when the upper end of the connecting rod in a vertical engine struck his head. The papers stated, "The poor fellow got his head in some way into the slot in which the piston works and his skull was crushed between the piston and the cylinder."

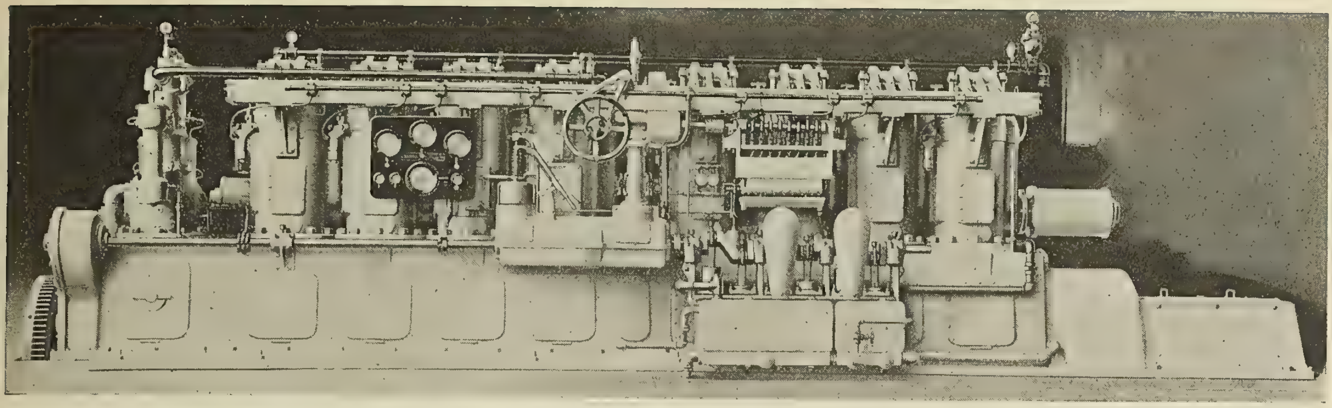


Fig. 1.—Operating Side of Eight-Cylinder Winton Diesel Oil Engine. Bore, 12 15/16 Inches; Stroke, 18 Inches

The Winton Marine Diesel Oil Engine

Detailed Description of Construction and Operation of Diesel Type Marine Engine Manufactured by Winton Engine Works

THE first Diesel engine designed and built by Alexander Winton at the Winton Engine Works, Cleveland, Ohio, was that type which at the time seemed to fill the greatest demand; that is, an engine for an auxiliary schooner or a vessel having a carrying capacity up to 4,500 tons. This meant an engine of compact design and of comparatively high speed and one that could endure this work for a long period of time. This type also lends itself to production in a large manufacturing plant, and in three years of service at sea, both in auxiliary schooners and full-powered motorships, has proved itself both reliable and economical.

One of a number of examples of Winton-equipped ships that has come to light recently is the *James Timpson,* which lately completed a 14,500-mile voyage, equipped with two six-cylinder Winton Diesel engines, operating at comparatively high speed and back-geared to the propellers through reduction gears. But this is only one of a half dozen or dozen other similar cases, although all different installations; and probably by the time this article

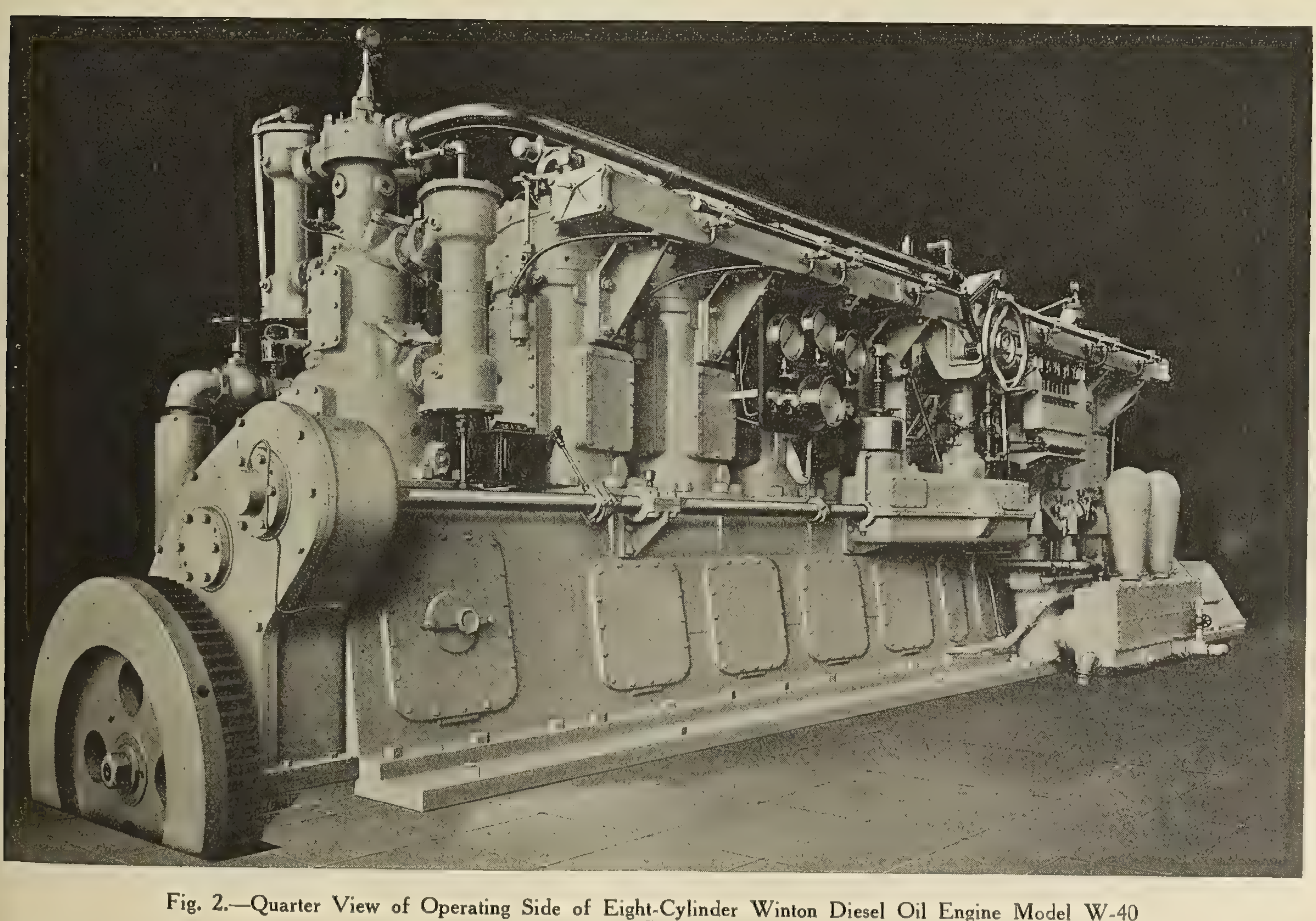


Fig. 2.—Quarter View of Operating Side of Eight-Cylinder Winton Diesel Oil Engine Model W-40

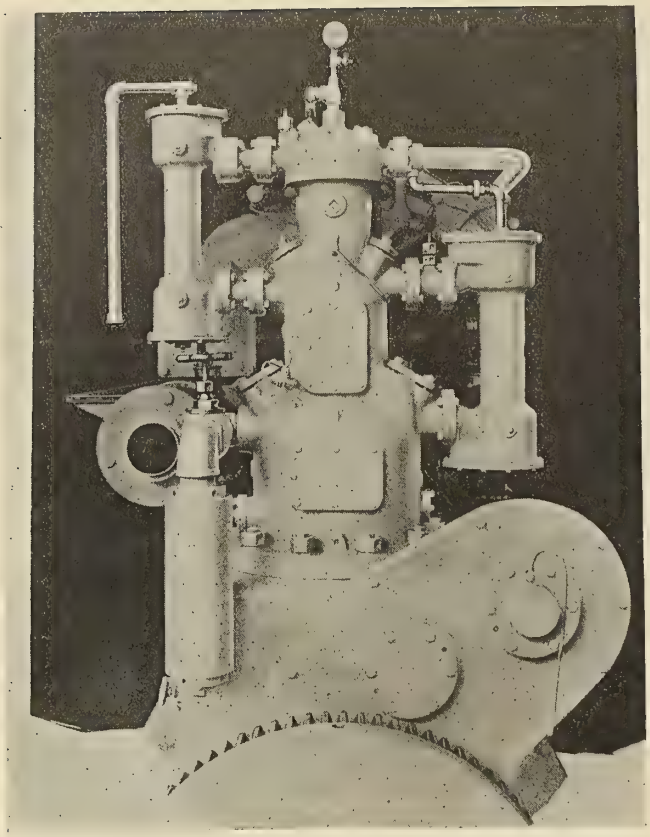


Fig. 3.—End View of 12 15/16-Inch by 18-Inch Engine, Showing Air Compressor

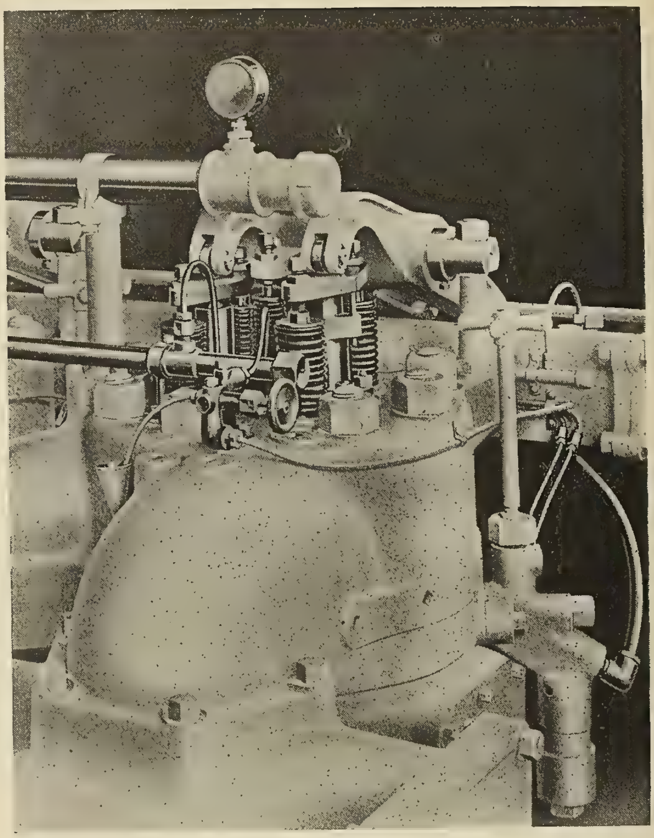


Fig. 6.—Completely Assembled Cylinder Head, Showing Valve Operating Mechanism and Fuel Injection Pipes

is in the reader's hands these same vessels will have added another twelve to fourteen thousand miles to their present logs.

There is naturally at this time widespread public interest in the development of shipping to sail under the American flag. There is not, however, equally widespread knowledge of the economies to be effected by the use of the heavy oil Diesel engine in place of the orthodox steam plant. These economies are two-fold; first, largely increased carrying capacity of a given size ship, due to the much smaller space requirements of the power plant, and, second, the greatly decreased operating cost.

Economies Effected by Use of Diesel Engines

Space saving is effected in several ways. The engine room proper is about the same size in either case, but with the Diesel engine the boiler room is entirely eliminated, as are also the coal bunkers, the oil fuel being stored in the double bottom, or in tanks occupying much less space than the bunkers. The crew's quarters are also much smaller,

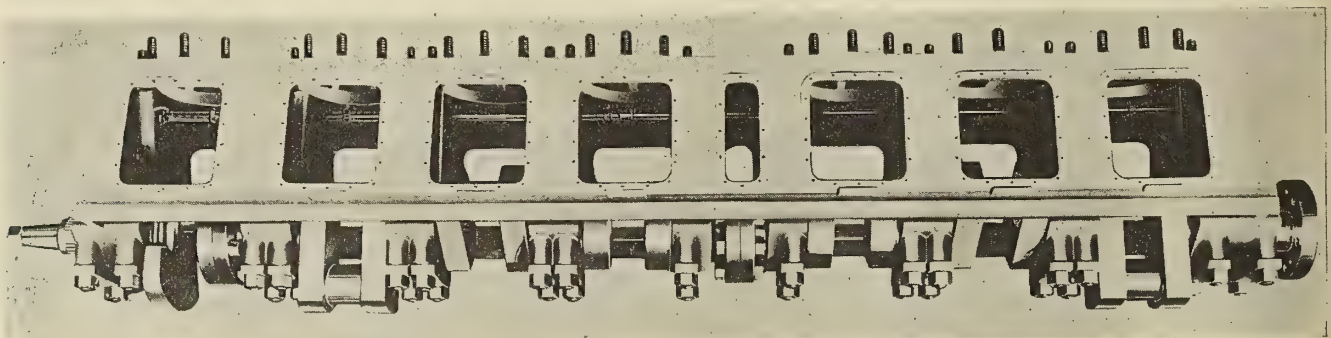


Fig. 4.—Upper Crank Case, Showing Method of Bolting Crank Shaft to Top of Case Instead of to the Bottom

Fig. 5.—Six-Cylinder Crank Shaft of Winton Diesel Oil Engine

as there is, of course, no boiler room force, and the engine room force is considerably reduced. The net carrying capacity of a 3,300-ton ship, 250 to 260 feet long, powered with two of these Diesel engines, is increased 15 percent over that of a ship with steam as motive power. But a few moments' consideration is required to realize the vast advantage given by this increased capacity, even if the operating costs were not reduced. Particularly is this true in view of the recent reductions in rates for ocean cargoes.

Reduced operating costs result from three sources, viz., cheaper fuel, smaller operating force, and less time required for a given voyage. The total cost of fuel oil is only about one-third that of coal. Roughly, about one-sixth as much deadweight of oil fuel is required as of coal, while the cost of oil is about twice that of coal per ton. The saving of man power, and consequently of living expenses during the voyage, is due to the elimination of the stokers and a reduction of perhaps one-third in the engine room force. In one case recently reported by Edward N. Hurley, chairman of the United States Shipping Board, the reduction was from 33 men on a steamer to 23 men on a motorship of the same size.

The saving in time results from the much smaller number of stops required for bunkering, and also because of the shorter time needed to pump the oil aboard as compared to that for loading an equal weight of coal. The figures as given by Chairman Hurley in the case mentioned above are as follows: The steamer stopped 14 times for coal in a voyage lasting 300 days. The motorship stopped twice in the same distance for oil, completing the voyage in 236 days, besides using some of her tank capacity for carrying a cargo of oil from one port to another.

The figures given above are by no means exceptional, as many records of even greater performances are on file. In addition to the above, there are many other advantages of the motorship over the steamer, which make its adoption desirable except perhaps in the largest ships.

Distinctive Features of the Winton Engine

The majority of the Diesel engines built in the past for motorships have either been constructed abroad or built in this country under foreign patents. These have usually been of the open crankcase, crosshead type, following accepted marine practice in the case of steam engines. Among the few strictly all-American designs, the Winton engine stands out because of its departures from the conventional accepted forms. That these departures have been in no way detrimental is proven by the successful records established during the past two years on many ships; on the contrary, they have permitted the construction of very light, compact units, running at higher speeds than have yet been generally accepted, and with sufficient reserve power for all emergencies.

Winton engines have been produced in the following three sizes:

Six-cylinder, 11 inches by 14 inches, known as Model W 35.

Six-cylinder, 13 inches by 18 inches, known as Model W 24 A.

Eight-cylinder, 13 inches by 18 inches, known as Model W 40.

Ordinary practice in the past in producing moderate-powered Diesel engines has been to copy the designs used in marine steam engines which the Diesel engines are to replace. This has resulted in clumsy designs, the extraordinary features being adopted with the idea of overcoming the expected prejudice of the engineer accustomed only to steam engines.

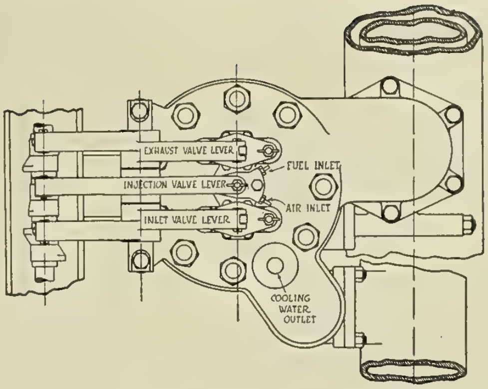


Fig. 7.—Plan of Cylinder Head

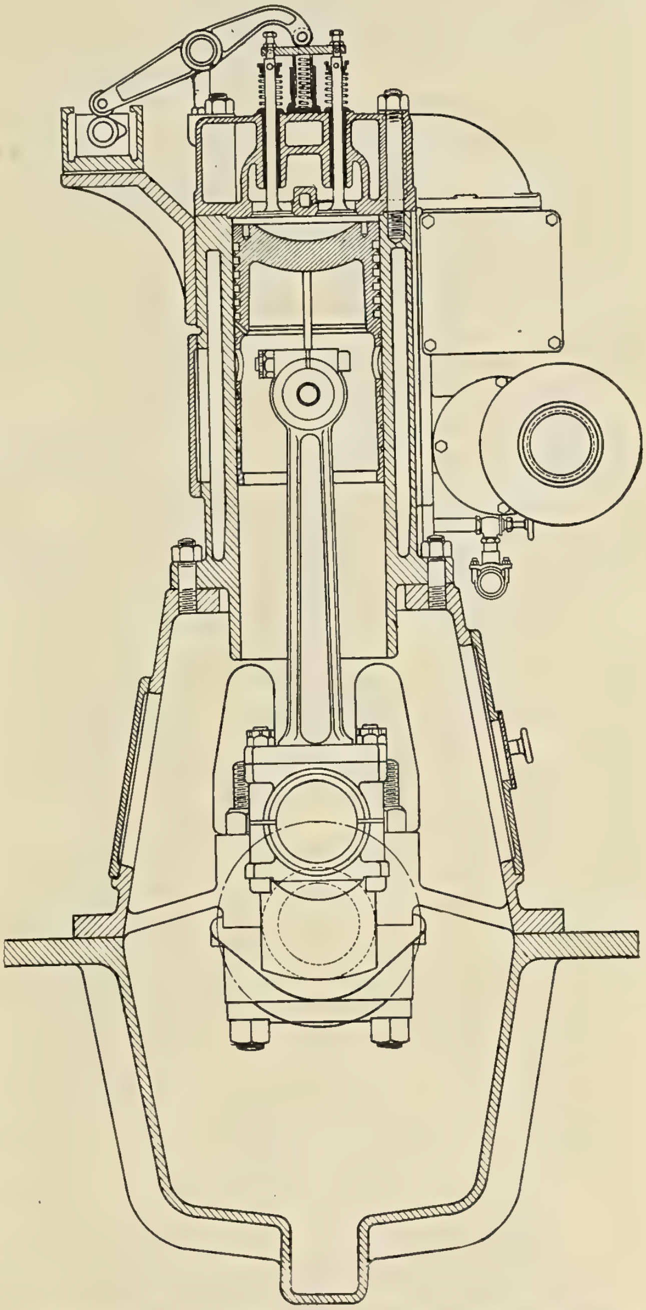


Fig. 8.—Sectional View of Cylinder and Details of Fuel Injection

In designing his engines, Mr. Winton departed greatly from this practice, and applied the proven principles of standard practice wherever they logically could be used. The outstanding features of his engine are: The use of

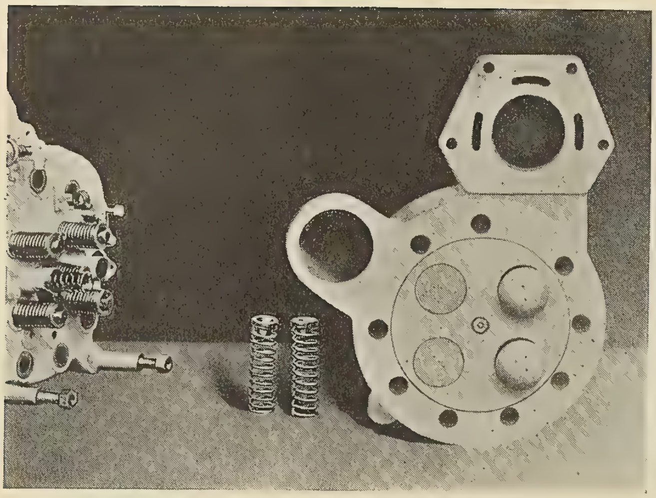


Fig. 9.—Part of Cylinder Head Construction

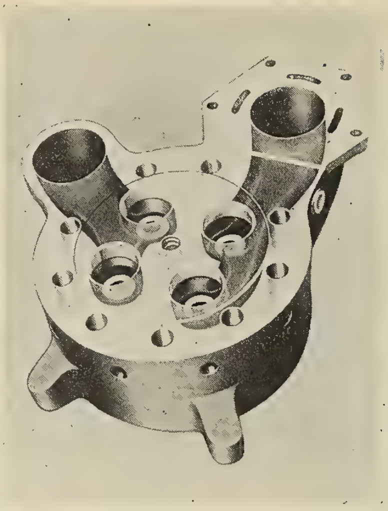


Fig. 10.—Phantom View of Head

an enclosed crank case, trunk pistons instead of the usual crosshead arrangement, and crank shaft bolted up to its bearings, which are mounted in the upper half of the crank case.

Method of Mounting Crank Shaft

This method of mounting the crank shaft, which is practically universal practice in gasoline (petrol) engine design, has two very important advantages. It is well understood that practically all the wear which takes place in main bearings is in the lower halves, as the thrust is in this direction in the power strokes. As wear takes place, the crank shaft drops slightly from its original position. If the wear is unequal in the various parts, the result is that the shaft is sprung more or less out of line, straining the shaft and reducing the effective output of the engine.

Where the lower halves of the bearings are fixed and the upper halves are bolted down to them, it is very easy in taking up loose bearings to spring the shaft seriously out of line. It is almost out of the question to lift the heavy shaft off its bearings to get at the lower halves; and, further, it is very difficult to determine when the bearings are exactly in line. On the other hand, if looseness develops where the shaft is bolted up to the fixed upper halves of its bearings, taking up the looseness simply restores the shaft to its original alinement.

The second real advantage of this mounting is that taking up wear in the bearings brings the pistons up to their original position again, so that the compression remains unchanged. Where the shaft is bolted down to its bearings the wear which inevitably takes place permanently reduces the compression. Naturally, the engine will operate most satisfactorily under the conditions for which it was designed and built.

Air Compressor

In Diesel engines the fuel is forced into the cylinder, against the compression, by compressed air at 850-950 pounds pressure. The high-pressure air for this purpose is obtained from the air compressor at the forward end of the engine. This cylinder is a three-stage air compressor. The piston is of the trunk type and is operated by a connecting rod, which is a duplicate of the connecting rods in the power cylinders, and a single-throw counterweighted crank shaft which is bolted to the front end of the main crank shaft. The throw of this single crank is somewhat less than that of the power shaft. Following each stage of the compression the air is water-cooled, so that on delivery it is at normal temperature.

The capacity of the air compressor is considerably in excess of that required for the injection of the fuel into the cylinder, providing for the initial charging and the maintenance of pressure in the storage tanks, or air bottles, which are used for starting the engine. There are two sets of these air bottles, one carrying air at about 600 pounds pressure per square inch, for starting the engine, and the other carrying air at 1,000 pounds pressure per square inch fuel injection.

Construction of Crank Case

The crank case is of gray iron, cast in one piece, of skeleton construction; that is, the sides have large openings opposite each throw of the crank shaft, each of which is provided with a cover plate, affording easy access to all parts of the interior. A main bearing for the crank shaft is provided on each side of each throw of the crank shaft, each bearing being supported by heavy ribs. The lower part of the crankcase is enclosed by a trough-shaped casting which extends from the timing gear in the front to the rear of the thrust bearing at the back end of the engine. The crank shaft and connecting rods are thus fully enclosed, so that there is no possibility of oil being splashed outside of the engine.

The bearing caps are each bolted up to the crank case by four large studs and nuts. The bearings themselves

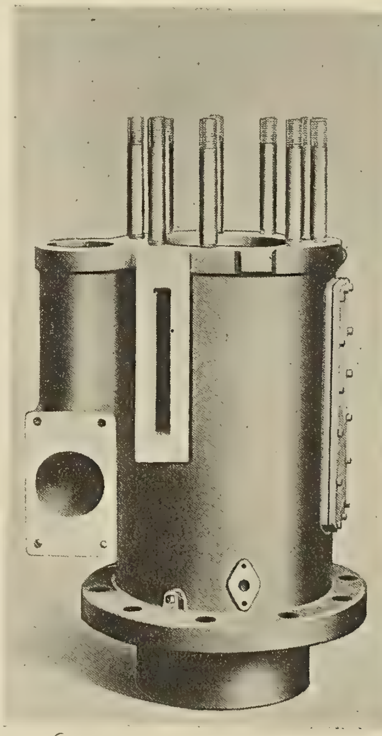


Fig. 11.—Cylinder, Showing Bolts for Attaching Head

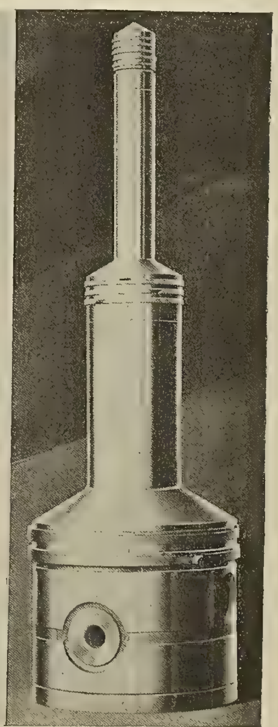


Fig. 12.—Piston of Three-Stage Air Compressor

are heavy shells, lined with high quality babbit metal. Each bearing has an individual oil lead from a header running the full length of the crank case. This header is connected to a two-cylinder reciprocating oil pump which maintains constant oil pressure on the bearings. Further details of this pump will be given later.

Crank Shaft Built in Three Sections

The crank shaft, because of the considerable weights and sizes of the forgings involved, is made in three pieces, two sections each having three or four throws for the power cylinder and a single throw section for the air compressor. These sections are flanged and bolted together before being assembled into the crank case.

From each main bearing of the shaft, a hole is drilled through the adjacent web to the crank pin. These holes register with grooves in the main and connecting rod bearings, so that the connecting rod lower bearings are also lubricated under pressure directly from the pump.

The connecting rods are I-section forgings, split at the upper end and clamped around the piston pins, and formed into a T-head at the lower end, to which two half-boxes and a supporting cap are bolted. Each rod has an oil-tube connecting with the groove in the upper half-box and leading upward to the piston pin. The piston pin itself is hollow with its ends plugged, and is drilled near each end so that oil is fed directly to the bushings in the piston. The tube and piston pin are thus filled with oil under pressure from the pump, thus lubricating the piston pin. The piston pin is case-hardened and ground, and bears on bronze bushings pressed into the bosses in the piston.

These piston pin bushings are grooved so that the oil will reach all the pin bearing surfaces. The surplus oil escapes onto the cylinder wall, providing lubrication for the pistons. Any excess oil works down and collects in the crank case. It is thus seen that all bearing surfaces are provided with positive lubrication.

Trunk Pistons

The trunk pistons are about 75 percent greater in length than in diameter. The piston pin bosses are located about one-third of the distance up from the bottom of the piston, which brings them to about the center of the effective bearing surface. The length of the bosses is such that the bronze bushings can be inserted from the inside. As each bushing is flanged, it is effectively locked against endwise motion when the connecting rod is in place.

The piston has the usual saucer-shaped top to give the necessary compression space, there being heavy ribs from its top to the side walls and the bosses. The piston is also strengthened by a rib around the inside, just above the bosses. To prevent oil from splashing up under the lower side of the head where it would be burned, the hole

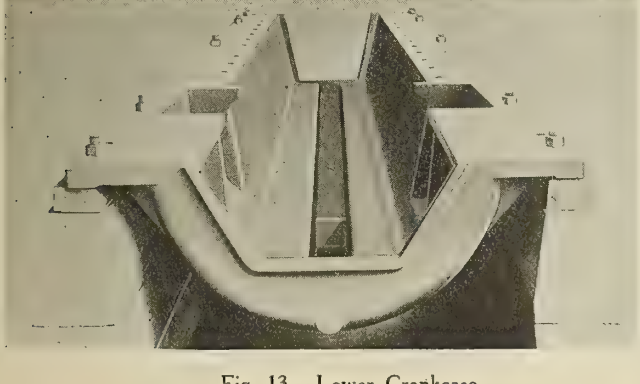


Fig. 13.—Lower Crankcase

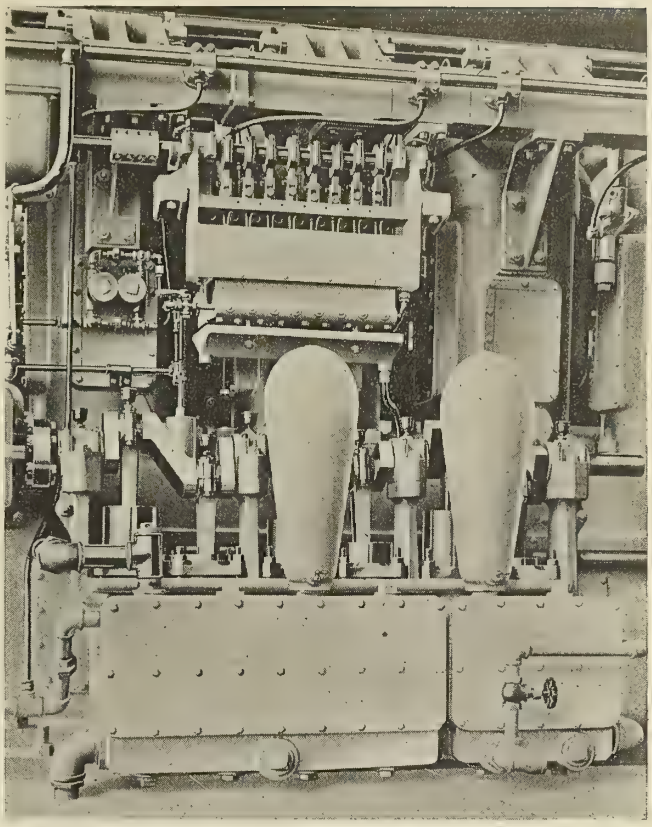


Fig. 14.—Oil Pump and Fuel Pump

through this rib is closed by a light sheet metal plate. This simple feature, it is claimed, has great influence in maintaining the quality of the lubricating oil, which would otherwise rapidly become very dirty. The usual piston rings are carried at the upper end of the piston. To prevent oil working up past the piston rings, a groove is turned immediately below the lowest ring, and from this groove a number of holes lead back into the inside of the piston.

To permit the handling of the bolt which clamps the upper end of the connecting rod around the piston pin, each piston has a hole through each side midway between the pin bosses and slightly above them.

Cylinders

The cylinders are cast individually with integral water jackets, there being large cover plates so that the jackets can be readily cleaned out if necessary. The cylinders are bored and then ground to very close limits, to secure an excellent fit of the piston and rings.

The cylinder heads are attached to the cylinders by studs and nuts so arranged that the pressure is uniformly distributed. Each head carries five valves, two for the incoming air, two for the exhaust, and one for the injection of the fuel. Each pair of inlet and exhaust valves is operated from the crankshaft by a single rocker arm, the valves being connected by a T-head guide on which the end of the rocker rests. The guide is carried in contact with the rocker at all times by a coil spring in the center of its hollow stem. Each end of the guide carries an adjusting screw and locknut, by which the clearance between the ends of the valve stem and slide can be adjusted. This clearance should be about .015 inch for both main inlet and exhaust valves. These pairs of valves are used instead of single large valves, as the small valves are much less apt to warp under the high temperatures to which they are exposed.

The fuel injection valve is located in the center of the head, and is also operated by a rocker from the camshaft. The adjusting screw for this valve is set to leave .025 inch clearance when the valve is closed. All these clearances are those for a cold engine, and will be somewhat less as the engine warms up.

Fuel Injection Valve

High-pressure injection air flows during all the time the injection valve is open. Fuel is injected, however, during part or all of this period, depending on the amount of power required from the engine. The amount of fuel is controlled by a centrifugal governor which limits the duration of the fuel pump suction as may be required to maintain the engine speed.

Fuel Pump

The fuel pump is of the plunger type, with one plunger for each power cylinder. It delivers the fuel to the fuel injection valve under a pressure of 850 to 950 pounds, depending upon the pressure of the fuel injection air. The stroke of the fuel pump is constant, the amount of fuel delivered being controlled by the governor, by the early or late closing of the pump inlet valve as noted above. The action of the governor is very delicate, as the speed variation with varying loads is very slight. This is, of course, a great advantage in a marine engine on which the loads may vary from one extreme to the other as the ship's propeller is deeply submerged or approaches the surface of the water in rough weather. The fuel oil is lifted to the fuel pump from the tanks by air at 10 to 15 pounds pressure.

The engine cylinders and air compressor are provided with circulating water by a 4-cylinder plunger pump, operating from the same crank shaft which handles the oil circulating pump.

Oil Circulating Pump

The oil circulating pump, which provides lubrication for all the main bearings of the engine, really consists of two single-cylinder pumps. The one driven from the end throw of the crank shaft operating the circulating water and lubricating oil pumps draws the oil from the pump in the lower half of the crank case and forces it through a cooler and a strainer to a storage tank. The other single-cylinder pump draws the oil from this storage tank and forces it into the header, from which it is piped to the bearings, as described above. The discharge side of the pump is provided with an air chamber to insure constant pressure being carried on these bearings. The circulating water pump is of the four-cylinder type and also has an air-chamber on the discharge side to insure steady circulation of the water. The cylinders, pistons and stuffing box glands are made of non-corrosive bronze to prevent injury by the water.

The camshaft is supported in a long box-shaped casting open at the top, which is in turn supported on brackets from the cylinders. This trough is partly filled with oil, for lubricating the cams; the camshaft bearings are lubricated under pressure from the pump, as are its driving gears.

The camshaft is driven by bevel gears from a vertical shaft near the center of the engine, which in turn is driven from a lay-shaft and a train of spur gears at the front end of the engine.

Action of Cams

The camshaft is provided with two complete sets of cams, for forward and reverse motion, respectively. Shifting the shaft endways by means of a handwheel and suitable mechanism brings either set of cams into operation. The shift from full speed ahead to full speed astern is guaranteed in six seconds, and is frequently accomplished in five seconds.

The procedure required to reverse the engine is as follows:

1. Close fuel oil supply valve.
2. Shift camshaft.
3. Open fuel oil supply valve.
4. Open valve controlling starting air.
5. Close starting air valve.

The supply of air for starting the engine is carried in steel air bottles which are from 12 to 18 inches in diameter and 10 to 20 feet long. These are stored wherever convenient on the ship and connected by heavy brass tubing to a header running the full length of the engine. At the point where the pipe from the air bottles joins this header, is located a valve which can be opened by pulling on a long handle. This admits the air to the header. Each cylinder is connected to the header by means of a pipe in which is located a valve operated regularly by the camshaft. The end of this pipe, connected to the cylinder, is fitted with a special casting containing three valves. The first is a check valve, to prevent the compression or power stroke pressure from escaping from the cylinder. The second is an overload or safety valve, which is set to open if the pressure in the cylinder exceeds normal power stroke pressure. A valve of this type is necessary to prevent damage to the cylinder or piston in case water or oil should accidentally collect in the cylinders. If this happens and the engine were started, the top of the piston would probably be broken out, as water or oil is practically non-compressible. The third valve in this casting is operated by a small handwheel and is opened only when it is desired to attach an indicator to determine the work being done by the cylinder.

The air inlets for both the air compressor and the main cylinders are connected to a large header, into which air is taken through a muffler at each end. This arrangement of drawing air for the engine directly from the engine room has the decided advantage of constantly drawing fresh air into this room, thus insuring ventilation.

Thrust Block

The thrust block at the rear of the engine has one unique feature, in that the thrust surfaces are lubricated under pressure from the engine oil pump. This thrust block consists of a short, heavy shaft, flanged at both ends, one flange being bolted to the rear flange on the crank shaft. Turned integral with this shaft are a number of large collars, between which the horseshoe-shaped thrust segments are mounted. Each of these segments is faced with babbitt on both sides and has a connection at the top to an oil lead from the pump. The babbitt facings are grooved so that the oil is distributed under pressure over the entire thrust surface. The segments are held in the proper position by nuts or heavy threaded shafts along each side of the thrust block. They are consequently readily adjustable for wear. They also are reversible, so that should the babbitt wear or burn off on one side, a new bearing surface can be brought into operation by a few minutes' work.

In general, the design has been very carefully worked out. The best of materials have been selected for each part, and the workmanship is excellent. All these factors contribute to obtain the excellent results which are reported each time a Winton-engine-equipped ship reaches port.

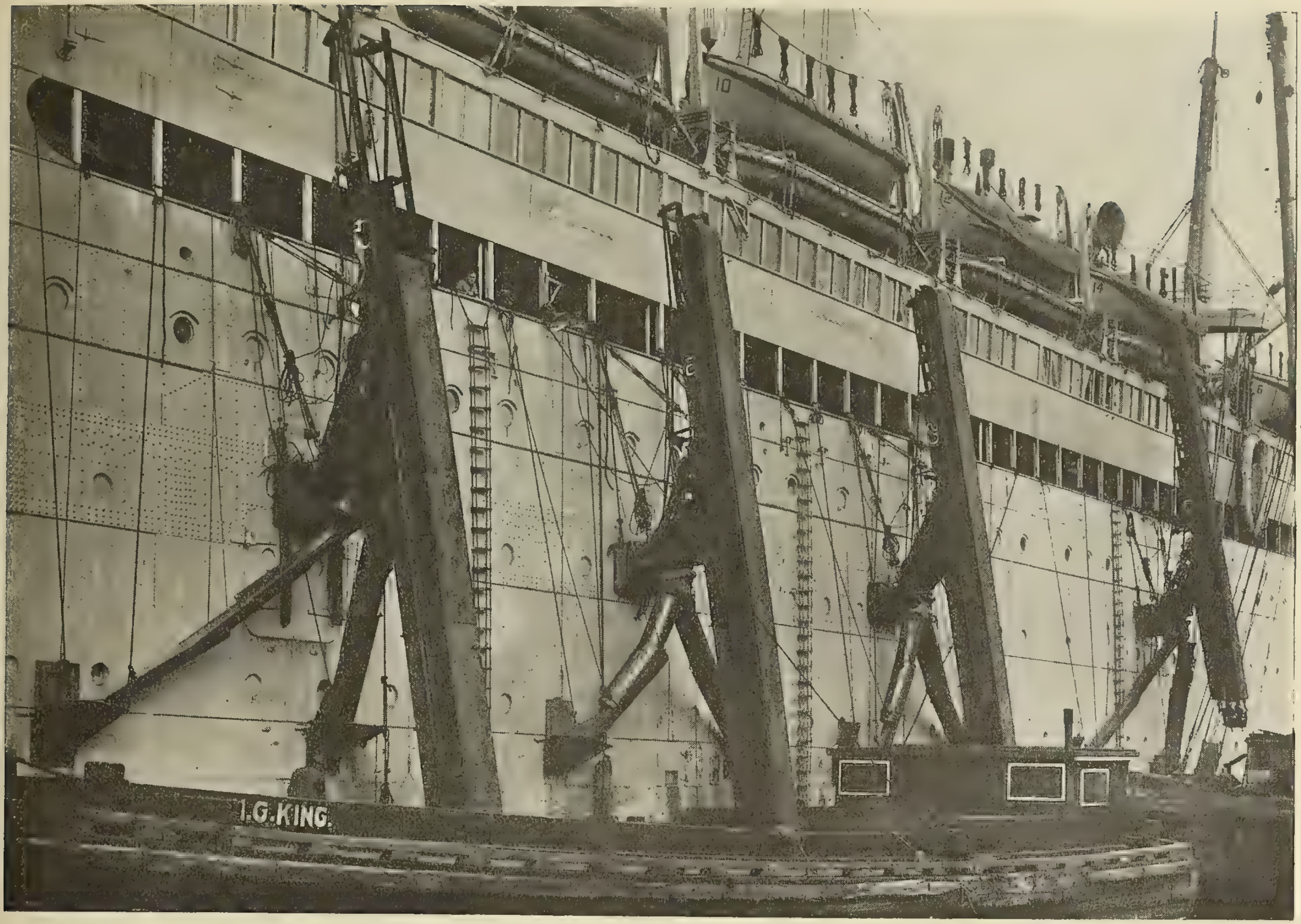


Fig. 1.—Coaling the *George Washington* in New York Harbor with Michener Elevators

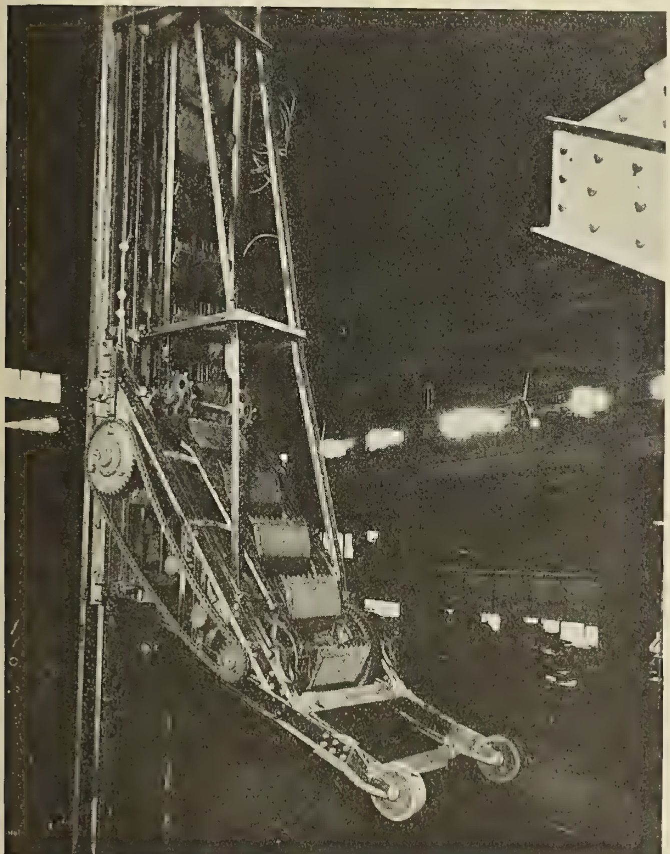


Fig. 2.—Michener Coal Elevator

Mechanical Coaling Apparatus Used on Large Liners

WITH the introduction of large vessels for ocean transportation, the old bucket-and-hoist method of raising coal from the barge to the coal-port became obsolete. In its place has been developed an efficient mechanical apparatus for filling the ship's bunkers without interfering with cargo handling or causing unnecessary disturbance. At the port of New York the Michener apparatus, manufactured by the Michener Storage Company, 17 Battery Place, New York, has been extensively used for this purpose.

The most conspicuous unit of this apparatus is the elevator, a portable machine, electrically driven and controlled, which is capable of raising coal from the barge situated at the ship's side and delivering it in a continuous stream to one or more side-ports, or overhead to a deck-hatch of the ship. Where cross-bunkers are available, the apparatus is well adapted for use on the off-side of the ship, in connection with the Michener trimming mechanism, although it will serve equally well on both sides. The elevator includes the head, in which is installed a driving motor, and the leg, which slides vertically through the head and is adjusted by raising or lowering, as desired.

The conveyor is of the endless chain and bucket type, the buckets engaging the coal at the foot of the leg. In operation the elevator is suspended from the side of the ship at any desired location by the head. It is maintained in this position by tackle attached to the deck or other available portion of the ship. The machine, which weighs about 13,000 pounds, is readily hoisted into place. The elevator, which is electrically driven by a ten-horsepower

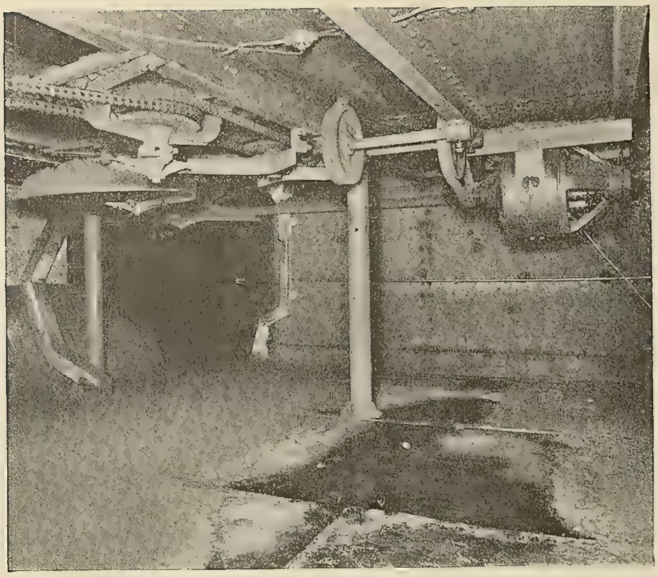


Fig. 3.—Bunker-Trimming Mechanism, Showing Disks, Plows and Attached Motor

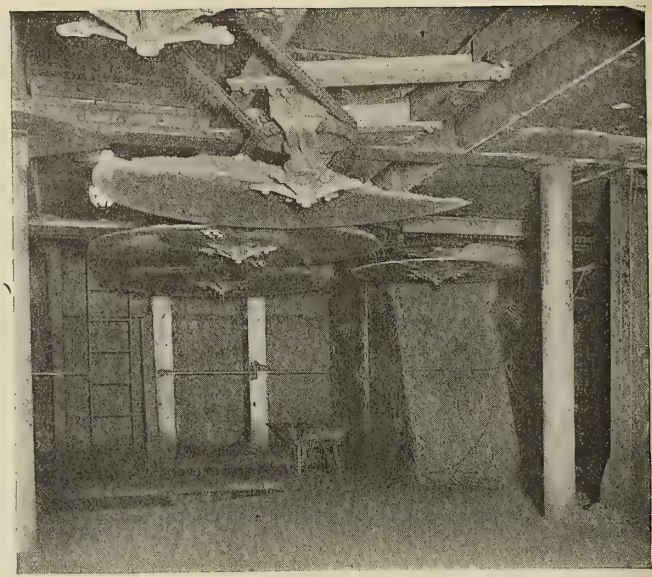


Fig. 4.—Series of Disks for Transferring Coal in Bunkers. Part of Disk Removed to Show Mechanism

motor, may be controlled by one man from the controller's box on the ship's deck or at some other convenient location. The motor and controller may be equipped for any specified voltage and for alternating or direct current.

The leg, which is provided with a safety device to prevent it from falling during operation, may be raised or lowered at the will of the operator. The apparatus is also guarded by a metal cover, so that the coal cannot drop upon the men stationed in the barges below.

Mechanism in Operation

In operation, the leg is raised sufficiently to allow a barge to move under it (see machine at extreme right in Fig. 1) and is then lowered into the coal. While the leg is being lowered the bucket chain begins to operate. The descent is gradual and automatic, so that, as soon as the apparatus touches the coal, the buckets fill and begin to elevate the coal to the ports. This descending movement is governed by a ratchet and pawl, which controls the leg while it is being lowered, allowing the ratchet to run ahead of the pawl when the leg reaches the coal.

The weight of the leg aids in the digging action of the apparatus. Should the resistance against the downwardly moving buckets, however, prove too great, the chain will automatically raise the leg and relieve the congestion.

The delivery point of the coal is established by the position of the head, which is adjusted high enough above the port into which delivery is to be made to allow a free run of coal down the chutes. Since the coal is only carried as high as the head, coal breakage, dust and unnecessary lifting are eliminated. At the moment of delivery, the bucket chain takes a horizontal course in the head, dumping the contents into the two-way discharge pipe, as illustrated. By means of a gate in this two-way nose, the coal may be delivered to either right or left chute. Other adjustments are possible with the apparatus.

Bunker-Trimming Mechanism

A special trimming mechanism is permanently installed in the ship's bunkers which automatically conveys the coal to all parts of the bunkers, piling it up between the deck-beams and heaping it up about the mechanism, so that every inch of available bunkerage space is filled.

By means of deflectors or plows, shown in the illustration, the coal is transferred from disk to disk. It may be noted that a part of the disk has been removed to show the mechanism more clearly in Fig. 4. Details of the motor and transmission gearing, and the sprockets and chains for driving the disks, are clearly shown. In the illustration the coal has been entirely removed from the bunker except for the slight amount which remains on the disks and framework, showing how evenly the disks are heaped with coal at the completion of the operation of trimming.

Capacity of the Apparatus

In actual installation, each unit, handled by one man, delivers 125 tons per hour. The disk-trimming mechanism will transfer about 150 tons of coal per hour from any port, or 50 tons in excess of the amount which the elevators can deliver under average conditions.

Large Wrecked Steam Engine Cylinders Restored by Oxy-Acetylene Welding

BY L. M. MALCHER*

THE following account should prove of more than usual interest to shipbuilders for two reasons—first, because much of the machinery found in shipyard shops and on large vessels is of massive construction like the broken castings referred to below, and, second, because the happenings in a steel mill—the shipbuilders' main source of supply—are of vital concern to the shipbuilder.

One of the big steel rolling-mill engines at the Farrell works of the Carnegie Steel Company, Farrell, Pa., that had been doing its full share in helping to win the war, broke down two weeks after the signing of the armistice, having worked constantly up to then on 100-percent war orders. In the accident, besides other parts, the left-hand low-pressure steam cylinder, 70 inches inside diameter, of an Allis-Chalmers twin-tandem compound reversing engine was badly fractured, as a result of the breaking of a connecting rod at the moment of reversal.

A serious situation confronted the officials of the Carnegie Steel Company, as it would have taken at least three to three and one-half months to obtain a new cyl-

* Superintendent, welding shop of Oxweld Acetylene Company, 36th street and Jasper Place, Chicago, Ill.

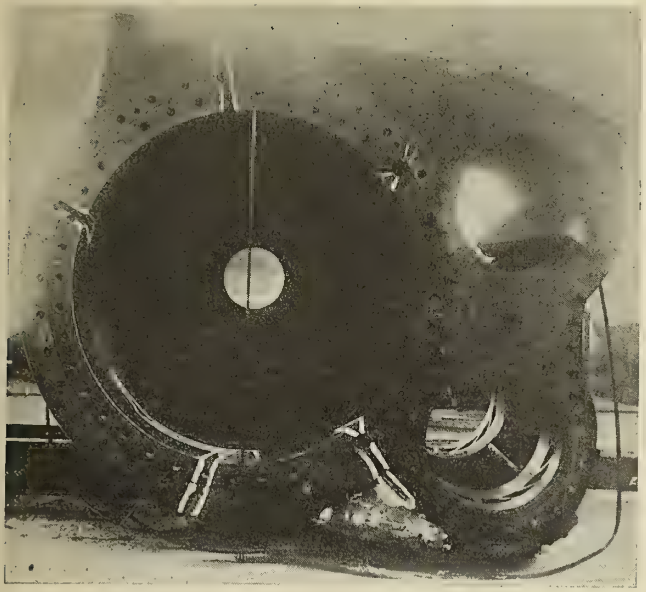


Fig. 1.—Wrecked Low-Pressure Cylinder, Showing Cracks V-Grooved by Chipping Preparatory to Welding. The Seven Cracks, All at Head End, Ranged from 1 to 8 Feet in Length and 2¼ to 3⅜ Inches in Depth

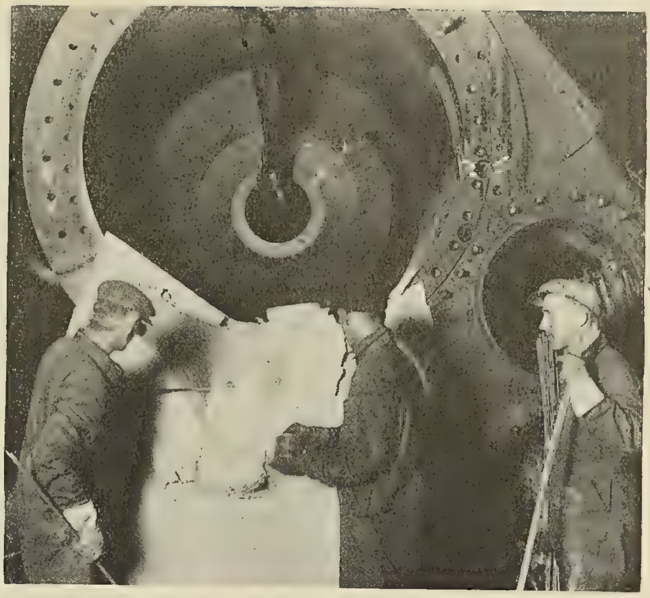


Fig. 3.—Welding the Low-Pressure Cylinder. Asbestos Paper Used to Protect Workers and Retain Heat from Preheating Fire. Extra Long Blow-Pipes and Rods Required for Welding Up the Long Cracks

inder, in case the broken one could not be repaired in a shorter time. Three hundred and sixty men were thrown out of employment. The broken cylinder was of such size and the damage done was of such character that a decision as to whether the cylinder was to be renewed or repaired involved a risk on the part of the management. Although considerations of expense as between the cost of purchasing a new cylinder and repairing the old one were of secondary importance, the cost of repairing was estimated to be about one-third that of a new cylinder.

The officials of the Carnegie Steel Company, after careful investigation, quickly decided in favor of oxy-acetylene welding. They called upon the job welding shop of the Oxweld Acetylene Company, Chicago, Ill., to meet the emergency. Three expert welders, accompanied by all the necessary equipment, went immediately to Farrell and completed the job under the direction of the writer. The total time consumed in repairing the low-pressure cylinder, including chipping, pre-heating and welding, was seventy-two hours. While dismantling the engine, a fracture 42 inches in diameter was discovered in the right-hand high-pressure cylinder. This fracture also was repaired in about eighteen hours. It took just seven days from the time the order was given to the Oxweld Acetylene Company to complete the entire job.

The data covering this work are given below:

Low-Pressure Steam Cylinder

5,000-horsepower Allis-Chalmers twin-compound reversing engine. The horsepower given is the maximum power developed while rolling and running at about 100 to 110 revolutions per minute.

Cylinder bore	5 feet 10 inches
Stroke	4 feet 6 inches
Weight of cylinder	13 tons
Thickness of iron casting	2¾ to 3⅜ inches
Number of cracks (see Fig. 1)	7

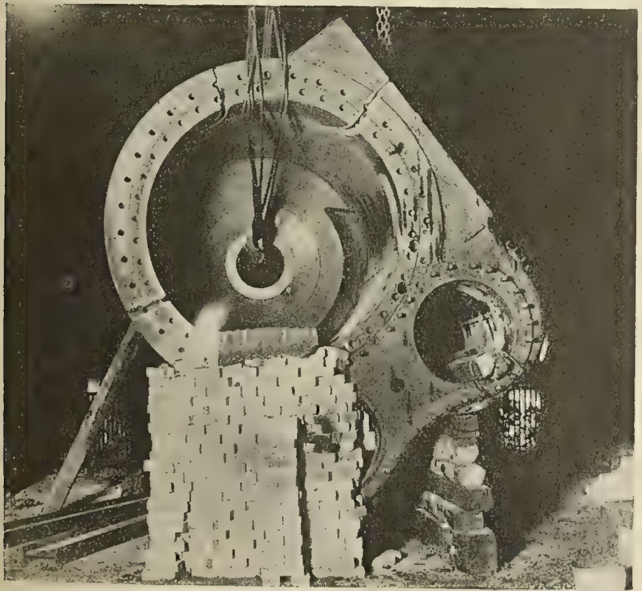


Fig. 2.—Preheating Crack in Low-Pressure Cylinder by Means of Charcoal Fire. Castings Handled by Crane

Fig. 4.—Welding of Low-Pressure Cylinder Completed, Casting Fully Restored

Total length of all cracks	22 feet 2 inches
Preparing and pre-heating casting	27 hours
Welding casting	45 hours
Linde oxygen consumed	2,850 cubic feet
Prest-O-Lite acetylene consumed	2,845 cubic feet
Oxweld cast iron welding rods	390 pounds
Oxweld "Ferro" flux	25 pounds
Number of welders	3
Period of welding shifts	10 to 30 minutes

High-Pressure Steam Cylinder

5,000-horsepower Allis-Chalmers twin-compound reversing engine.

Cylinder bore	3 feet 6 inches
Stroke	4 feet 6 inches
Weight of cylinder	5 tons
Thickness of iron casting	3½ to 6 inches
Piece of flange broken off (see Fig 5)	
Total length of weld	4 feet 6 inches
Preparing and pre-heating casting	9½ hours
Welding casting	8½ hours
Linde oxygen consumed	650 cubic feet
Prest-O-Lite acetylene consumed	650 cubic feet
Oxweld ¼-inch cast iron welding rods	110 pounds
Oxweld "Ferro" flux	10 pounds
Number of welders	3
Period of welding shifts	10 and 30 minutes

While welding inside of the cylinder castings the men relieved one another every ten minutes because of the ex-

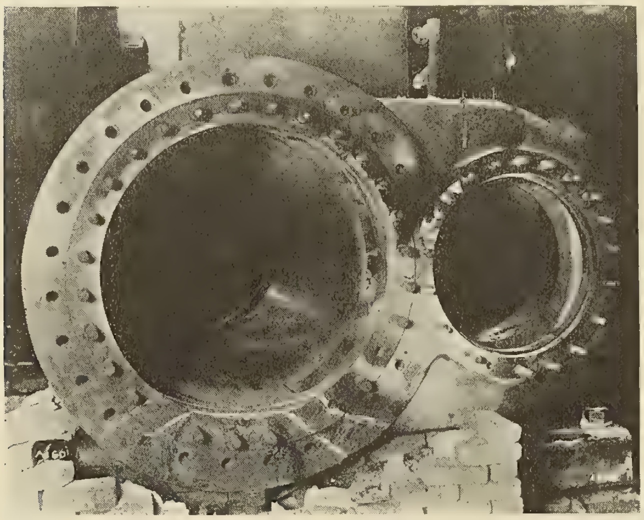


Fig. 5.—Flange Welded on 5-Ton High-Pressure Cylinder. Weld 4½ Feet Long, 3½ to 6 Inches Deep

treme heat deflected back on them during the welding operation. On the outside welding, however, the heat was not so intense and the men relieved one another every thirty minutes.

After the engine cylinders were machined, it was almost impossible to determine where the cracks occurred. The total cost of this repair represents but a small fraction of the replacement cost, but even this saving is insignificant when compared with the disorganization which would have resulted from the laying off of a large body of trained workmen and with the enormous loss that would have been entailed in a stoppage of production.

Oxy-Acetylene Welding at the Morse Dry Dock

THREE hundred burners and welders are employed at the large ship repair yard of the Morse Dry Dock & Repair Company, Brooklyn, N. Y. Rivets, plates, angle irons and channel iron, staybolts and boiler tubes and many other parts of ships are quickly cut with the oxy-acetylene torches at a very low cost.

The welders are reclaiming many broken castings, thereby saving both time and money. Among the more important parts reclaimed are broken pump cylinders of various sizes made of cast iron and steel. The savings made in this way are shown in the following report made by the Morse Dry Dock & Repair Company to the Air Reduction Sales Company, New York:

Broken Air Pump Cylinders

Diameter of cylinder, from 6 to 24 inches.
Weight of cylinder, from 50 to 600 pounds.
Cost of welding, from \$2 to \$25 (8/4 to 5/4/2).
Saving involved, from \$75 to \$1,000 (14/11/8 to 208/6/8).

Cast Iron and Steel Gear Wheels

Diameter of wheels, from 1 to 12 feet.
Weight of wheels, from 25 to 1,000 pounds.
Cost of welding, from \$1 to \$200 (4/2 to 20/16/8).
Saving involved, from \$10 to \$4,000 (2/1/8 to 833/6/8).

Cast steel anchor chain winches, known among shipbuilders as "wild cats," become worn and are built up and reclaimed for less than \$10 (2/1/8), thus saving \$250 (52/1/8).

Brass propeller shafts when worn are quickly built up by this method, saving from \$100 to \$4,000 (20/16/8 to 833/6/8). These shafts range from 4 inches to 24 inches in diameter and 1½ feet to 30 feet long.

Cracked Steel Shell Plates Reclaimed

Size of Plates	Thickness	Saving
3 feet by 27 feet	⅞ inch	\$500 (104/ 3/4) each
4 feet by 6 feet	½ inch	75 (15/12/6) each

Cast iron compass stands with broken lugs and bodies, weight 150 pounds, are reclaimed with a saving of \$50 (10/8/4) each.

Many other castings are also reclaimed by the oxy-acetylene method.

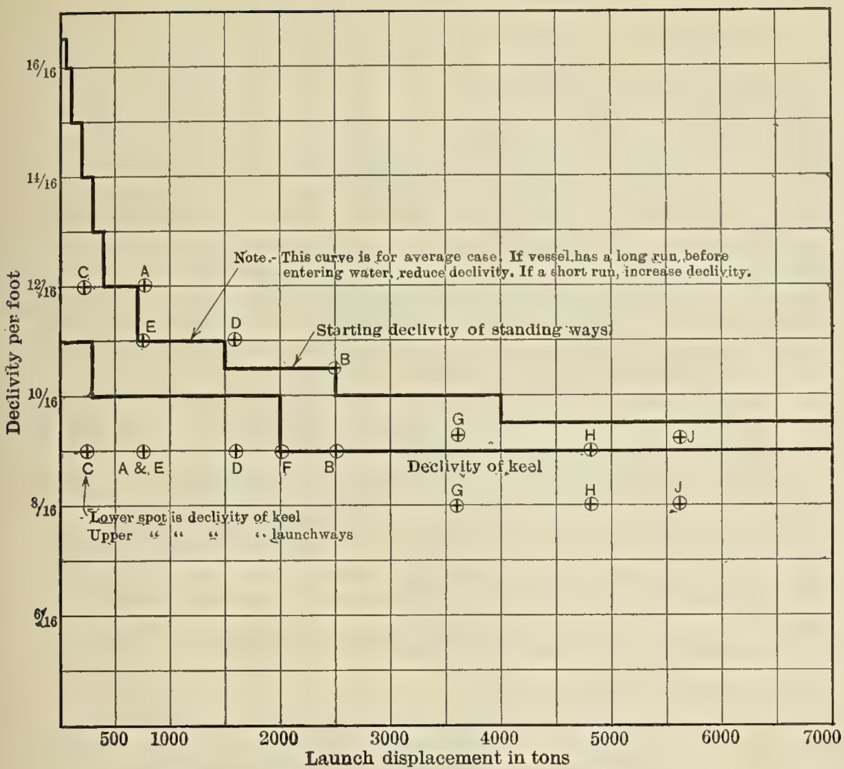
Declivities of Launching Ways

BY W. JONSEN

THE accompanying curve indicates in a simple form suitable declivities of keel and launching ways for vessels of varying size and similar type, the type dealt with being cargo vessels of ordinary form.

Local conditions, such as the natural slope of the ground, extent of water available in front of the building berth, length of run before entering the water, and amount of rise and fall of tide, are, of course, factors which may influence these declivities; but, assuming average conditions to hold, the curve may be taken to represent sound practice. If the vessel has any considerable distance to run

Vessel	A	B	C	D	E	F	G	H	J
Type	Barge	Dredger	Tug	Passenger	Cargo	Cargo	Cargo	Cargo	Cargo & Pass'gr
Principal dimensions	230'x 38' x 15'	330' x 53' x 22'	130' x 26'x13'	370'x47 x19	230' x 36' x 17'	340' x 44' x 26'	440' x 53' x 39'	480'x 56' x 36'	500' x 56'x 36'
Launch displacement in tons	750	2500	240	1600	750	1980	3600	4800	5600
Declivity of keel	9/16	9/16	9/16	9/16	9/16	9/16	½"	½"	½"
Declivity of tangent to standing ways	12/16	21/32	12/16	22/32	11/16	9/16	37/64	9/16	37/64
Camber in length of slide	7"	12"	2"	18"	Nil	7"	7"	12"	15"
Length of slide in feet	180	295	90	310	192	285	360	405	425
Width of slide in inches	22	22	14	22	14	33	33	33	33
Area of slide in square feet	655	1080	210	1135	450	1570	1970	2230	2320
Pressure per square foot on ways in tons	1.15	2.3	1.15	1.4	1.67	1.27	1.83	2.15	2.4
Water on way ends	Nil	Nil	4' 6"	3 6"	1' 6"	1' 0"	4' 0"	4' 6"	4' 0"



Declivity Curves for Keel and Launching Ways

before entering the water, the declivity indicated by the curve for vessels of over 1,000 tons launching displacement should be reduced by an amount of from 1/32 inch to 1/16 inch per foot, according to local conditions.

The table gives particulars of vessels which have been successfully launched; in these cases the start was frequently slow, and the length of run before entering water gave the vessel sufficient speed safely to clear the launchways. In consequence, it will be noted that the curve indicates declivities generally in excess of the actual cases quoted.

Camber has been stated in the table over the length of the slide, as it will be a simple matter to proportion the camber over any length of standing way. Introduction of appreciable camber calls for judgment and experience, as care must be taken that for a long length of standing way the camber does not result in too small a declivity below the center of the vessel when still at rest, and that too great a poppet pressure does not obtain when the stern lifts. If good judgment is exercised, however, camber may have the effect of considerably shortening the standing ways.

Development of River Docks and Terminals on the Mississippi River

SINCE the Government appropriations were made for the building of modern barges and towboats for use on the Mississippi River, the cities using the service have made rapid progress in the development of terminal facilities. The concrete terminals which are being constructed at St. Louis were described at length in the April issue of Marine Engineering.

The city of Alton, Ill., one of the first ports to complete its river terminals and docks, has installed an unusual type of freight-handling machinery at that point. Among the apparatus utilized is a Brown portable barge-loading device. This is constructed so that it may be used on steep and sloping banks, can be adjusted for high and low water, and provide for both loading and unloading service. The equipment, which is comparatively inexpensive, is suitable for installation at the smaller ports.

The city of St. Paul is building a double-track trestle on the river front about 800 feet long and constructing a levee about 100 feet wide along the side. The city has installed a Horton & Steinbrenner locomotive crane and a gantry crane. Chutes and hoppers have also been built in the floor of the bridge owned and controlled by the St. Paul Bridge & Terminal Railway Company. This provides for the rapid unloading of iron ore from railway cars to the barges.

Other cities are actively engaged in gathering data and raising money to construct adequate port facilities. The city of Memphis, Tenn., has a committee working out details for a $500,000 (£105,000) terminal project. The city of Shreveport, La., is also actively engaged in planning the construction and equipment of barge terminals. Greenville, Natchez and Louisville, as well as other cities along the Mississippi and Ohio rivers, are working out definite plans for terminal developments. The city of Helena, Ark., has already raised $20,000 (£4,100) as a preliminary fund for the development of docks and terminals at that city, according to the report of L. R. Parmelee, city engineer.

Shipbuilding at the Pensacola Yards

BY JOHN M. SWEENEY*

AT the Pensacola Shipbuilding Company's new yard at Pensacola, Fla., there was launched on March 15 the 9,000-ton cargo ship *Cushnoc*, establishing a record for the side-launching of a vessel on the Atlantic or Gulf coasts. It is quite unusual that first launchings in new yards occur without a hitch of some kind, but the launching of the *Cushnoc* could not have been more successful in the oldest yard and with the best trained force of men accustomed to such work.

The Pensacola Shipbuilding Company has built its yard with the object of doing the work properly and thoroughly. Consequently, the company has in no way been tempted to hurry the launching at the expense of proper testing of the work before launching. This is applied particularly to the tank testing, and the result of this policy is seen in the case of the *Cushnoc*, which went overboard without showing a leak or developing a mishap of any kind.

The Pensacola Shipbuilding Company has been particularly fortunate in securing the supervisory services of David Hunter, in charge of the National Shipyard at Violet, La. To Mr. Hunter's knowledge, care and forethought are particularly due the successful launching of the *Cushnoc*. Mr. Hunter was ably assisted by Bill Michel, of the Emergency Fleet Corporation.

Immediately after the *Cushnoc* had cleared the ways, the keel of the next ship was put on the blocks. The Pensacola Shipbuilding Company operates five ways and has four other ships approaching the launching period, which will follow the *Cushnoc* in close succession.

* President, Pensacola Shipbuilding Company, Pensacola, Fla.

Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Extra Bench Grinder

The engine room oilers were forever pestering the life out of the shop machinist in using the emery wheel and taking off the wheel to put on a buffing rag. One day one of them asked permission to make up an extra wheel stand, telling the chief he could do so with an old, worn-out motor boat gas engine piston.

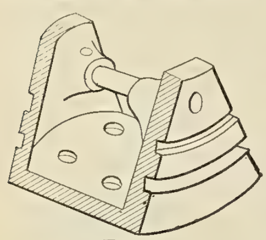


Fig. 1

The sketches show how he rigged up the device. The piston was machined down to the shape shown in Fig 1. The old wrist pin was removed and the holes slightly enlarged by reaming, then twin bronze bushings were fitted and a small steel shaft made for the emery and buffing wheels. A pulley was turned up to

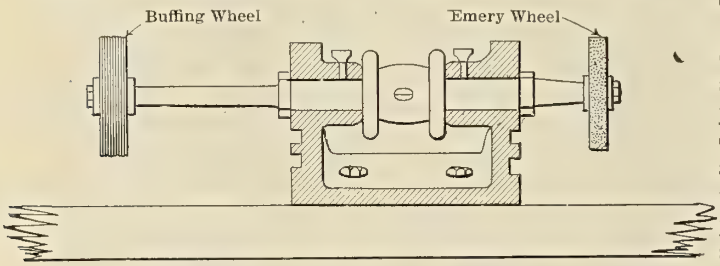


Fig. 2.—Handy Extra Emery and Buffing Wheel Made from Old Motor Boat Engine Piston

fit the space in the center and secured with a blind set screw.

Check nuts were used for thrust collars on each end outside the piston. Oil cups were put in on the bosses inside and this completed the idea. The rig was securely fastened to the bench and run at proper speed.

Concord, N. H. C. H. Willey.

Watching the Little Things

That an ounce of prevention is better than a pound of cure is an adage that is no less true than that a stitch in time saves nine. The latter, as well as the former, applies on shipboard equally as well as on "dry" land. Emergencies arise in the operation of vessels—particularly in the engine room—which are liable to develop into serious trouble, if not completely stop the vessel, unless adequately met and overcome before the thing is too late. I know of one instance that happened on the ship where I was chief that would have proved a dire mishap if I had listened to the advice of others, especially my otherwise friendly and capable second assistant engineer.

We had just rounded the Horn on our way from San Francisco to New York. I happened to be in the engine room for some reason or other and, passing the main steam riser, I caught a slight puff, like a pin-prick, against my cheek. Instantly I thought of a leak. I carefully examined the pipe but could locate nothing that gave even the semblance of a crack in the riser. Yet as I sought I again felt the pin-prick against my cheek. I was a bit troubled. We were running under 185 pounds of steam, and a break in the steam line meant, of course, serious consequences. I called to the assistant and put the thing up to him. He felt around the joint—the leak, if leak it was, was in the vicinity of the flanges—and he likewise was convinced that something was wrong. Yet he fairly grinned when I suggested that we cut down the pressure to 150 pounds as soon as possible and set up around the piping some form of reinforcement. But I insisted that this be done.

We got busy. We made a clamp out of flat iron stock, in two pieces, with the proper bolts for staying, and clamped this around the pipe at a point immediately above the topmost flange, which was where the puff of steam was coming from. Then, despite the smiles of my second assistant, I saw that the pressure was lowered in the boilers from 185 pounds to 150 pounds. Under this reduced pressure we came on to New York.

As soon as we could, we took down the main line and examined it for pinholes, which was what my second assistant declared to be the source of the trouble. And do you know what we found? The main steam pipe was cracked from the flange up to a point some seven inches above the flange! It was an almost imperceptible crack, to be sure. Nevertheless, had I not reduced the steam pressure and placed a reinforcement around the pipe, we should undoubtedly have experienced some very annoying times in that engine room in order to bring the ship to port.

"Chief."

A Successful Method for Drawing Keys

There are many and various ways of drawing gib-headed keys, though there is only one real method of getting a strangle hold and utilizing all of the strength of the key section in such a way as to start the key, which is the

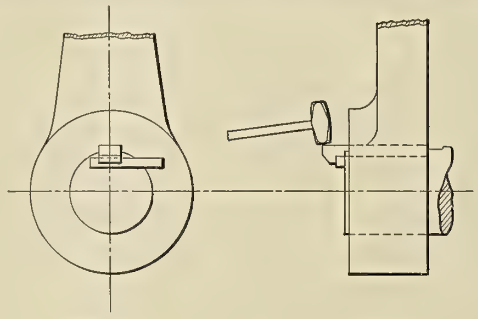


Fig. 1 Fig. 2

biggest part of the job, and which must appeal to the mechanic who has never tried it. After shooting, which is not always practical or possible, this is the next best method:

A piece of square-section tool steel with the very slight-

est amount of taper is properly fitted under the gib, which should also be filed to the same taper, so as to make a perfect metal-to-metal fit. This piece is driven in tight enough to feel solid, though not enough to cause bending or fracture.

The amount of care with which this piece of steel is fitted is always worth the amount of time spent on the job; as, should the gib be broken off, it means drilling and tapping for the stud to draw it out. Should this fail, careful drilling must be resorted to in order to get as much section out of the key as possible, thereby loosening it. After the foregoing work is done, the key is marked with a scriber and a good stout blow given it on the opposite side to the fitting piece, and, in almost every instance, on looking at the scriber mark, the key will be found to have started. The fitting piece is again set up as before and the process repeated as often as necessary, using shims to build up until it is loose enough to draw with a pinch bar.

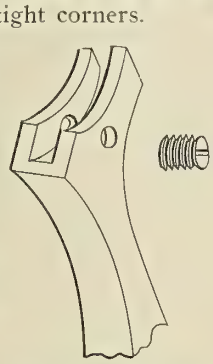
Seattle, Wash. SEAGOING ENGINEER.

Unique Angle Wrench

This wrench is the result of experimenting to see what could be done to make a handy open-end wrench that

could be used at all angles. The need of such a tool is obvious to those who have to carry about a lot of solid wrenches in order to get at nuts in tight corners.

This wrench is made of good steel. It is in two pieces—the wrench jaws and the handle. It can be made to answer for six different angles of solid wrenches, the screw or pin being the means of locking the handle in any position desired. The outside edge of the wrench is a true circle and the handle conforms to this. A series of six holes for the pin is drilled as shown. MECHANIC.



Improvised Angle Wrench

Useful Information

A very good paint for smoke pipes, boiler casings, gas engine mufflers, or anywhere that a heat-resisting paint is needed, can be made as follows: Mix thoroughly three parts of graphite, two parts of black oxide of manganese with nine parts of fuller's earth. Then to this mix a compound of one part glucose, ten parts sodium silicate, and four parts water. Stir until it is all of the right consistency to apply with a brush.

Paint brushes that have been allowed to become hard can be revived for use if treated in either of these ways: First method, soak them a few days in turpentine, then remove and wash with yellow soap and hot water, working the bristles with the fingers, then wash the brushes with gasoline (petrol) and rinse out with kerosene (paraffin). Second method, soak them in hot vinegar.

Drilling Glass

By mixing camphor with turpentine, one can use a regular twist drill to put holes in glass. Make a small circular dam of putty to hold the drilling compound; drill steadily and with moderate pressure. When the point of the drill starts through the glass, stop drilling and finish the hole by reaming with a three-corned file which has its edges ground sharp.

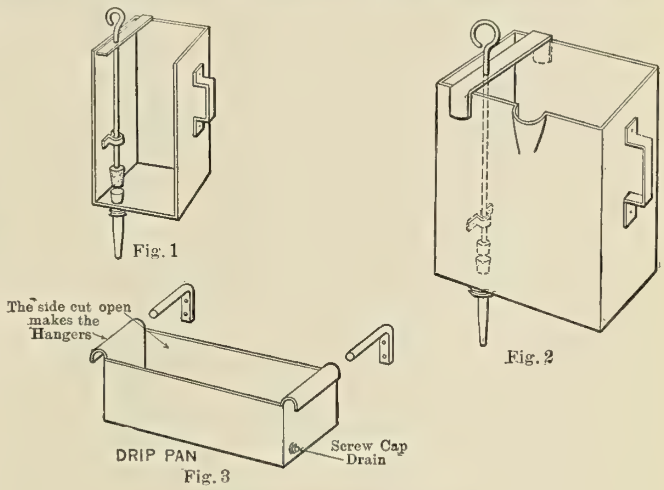
Keeping Putty

Sometimes when a pane of glass has been set there is a handful of putty left over. This will come in handy if preserved. Wrap it in a piece of brown paper, put it in a fruit jar and cover it with water; then screw or clamp on the jar top. This prevents the water evaporating. Putty will keep indefinitely when taken care of in this way.

C. H. W.

Uses for Oil Tins

In spare time a few useful articles can be made from empty five-gallon oil tins. A very handy oil cup filling device that I made is shown in Figs. 1 and 2. It is very simple to construct, as follows: Cut out the bottom of the oil tin and next transfer the handle from the top to the side. Next make a small long-taper funnel that will fit inside the screw-top opening. Solder this in place on the inside of the can. A long rod fitted with a small cork



Special Uses for Oil Tins

stopper on one end and working in brackets soldered to the inside of the can is used as a valve to open or close the funnel opening. A lip is made on one edge of the tin for pouring out the remaining oil after all cups have been filled.

Fig. 2 shows a simple way to make a small drip pan to use under the oil filter or tank; it is made by cutting open one side of an empty tin and bending back a section of this to form the hangers by which it is set on two simple brackets. As the can has a screw cap at the one end, it provides a handy method of draining it out.

ASSISTANT.

Testing Compression

The other day I was visiting a ship tied up to the other side of the same dock at which we were berthed, and for this visit of a few minutes and short distance I was rewarded with a couple of kinks worth remembering.

One of them I have illustrated with a sketch. It is a simple idea, but one that I, and perhaps many others, never thought of. The second engineer was giving the ship's motor launch engine an overhaul, and at the time I arrived he was testing the engine cylinders for compression. For this purpose he had rigged up a small pressure

gage, using the base of an old spark plug for this purpose. The use of a small pressure gage in this manner accurately indicated the condition of the piston rings and valves of each cylinder tested.

The other kink is shown in Fig. 2—a very powerful

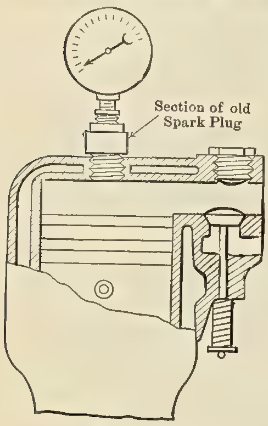


Fig. 1

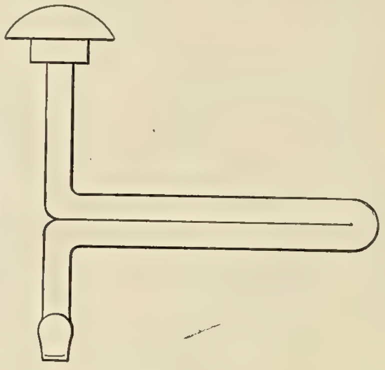
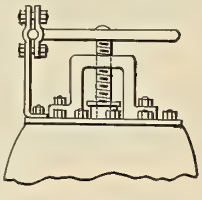


Fig. 2

type of screw driver that is quickly and easily made from a piece of ⅜-inch round stock. It is for driving in or taking out stiff screws. C. H. W.

An Ingenious Clamp for Preventing the Opening of Sea Injection and Overboard Discharge Valves When Putting a Ship Out of Commission

In order securely to close the sea injection and overboard discharge valves of our ship when putting it out of commission, I have found the clamp described below helpful. As the idea may be useful to other marine engineers, it is submitted for publication.



Arrangement of Clamp

The clamp is made from flat iron or steel 3/16-inch or ¼-inch thick and as long as the distance from the bonnet to the handwheel, with allowance for bending the foot and forming the upper end. The valve should be closed when taking the measurement. One of the studs should be removed and replaced by a longer one, according to the thickness of the metal of the clamp.

After forging the clamp, a short strap is shaped to fit the handwheel. Corresponding holes are drilled at each side of the forged part, fitting the handwheel. A clearance hole is drilled in the foot of the clamp to slip over the stud in the bonnet. The clamp should be fitted so that the short strap comes on the inside of the handwheel. If it is necessary to use the valve again, a few minutes' time is sufficient to unbolt the strap.

In securing the feed and steam stop valves of a boiler when required to work inside, this type of clamp does the job in a first-class manner, as it cannot be accidentally opened, admitting steam or hot water on the workmen in the boiler.

U. S. S. *Iowa*. Fred W. Mierke.

From January 1 of this year to May 7, a total of 204 steamships with an aggregate of 781,980 gross tons were delivered to the United States Shipping Board by American yards. From January 1, 1918, to December 31, 1918, the output was 527 steamships with an aggregate gross tonnage of 1,991,587.

NEW BOOKS

Bureau Veritas, Repertoire-General (General List of Merchant Shipping of All Nations). Volume I, Steamers and Motor Vessels, 1918-1919. Size, 10½ by 11 inches. Pages, 1,182. Volume II, Sailing Vessels, 1918-1919. Size, 10½ by 11 inches. Pages, 795. New York, 1919: Bureau Veritas. Price (two volumes complete), $25.00.

The Repertoire-General, issued yearly since 1870 by the Administration of the Bureau Veritas, is printed in two volumes, one dealing with steamers and the other with sailing vessels. The first volume contains an alphabetical list of all sea-going merchant steamers and motor vessels of 100 gross tons and upwards of all countries of the world excepting barges, ferry boats, dredges, yachts, etc., and vessels for inland navigation. Vessels of the Great Lakes which are partially employed for ocean service are included in this list. The volume also contains the following lists: Petroleum-carrying steamers, cable ships, changes of name, compound names, steamers of 10,000 gross tons and upwards, signal letters of all nations, builders of iron or steel, wooden and ferro-concrete ships, owners of steamers and motor vessels in the order of nationality. During recent years lists of vessels fitted with refrigerating apparatus and a list of salvage companies have been added.

The second volume contains an alphabetical list of all sea-going merchant sailing vessels of 50 gross tons and upwards of all countries of the world, followed by a separate list of sailing vessels fitted with auxiliary engines or motors. This volume likewise contains a list of changes of name, a list of vessels having compound names, the signal letters of all nations and a list of owners of sailing ships.

Each volume contains also a table showing general statistics arranged according to nationality of the vessels therein and a table showing statistics of the vessels built, bought or sold in the different countries during the preceding year.

The Delamater Iron Works: The Cradle of the Modern Navy. By H. F. J. Porter, M. E. Size, 8¼ inches by 10¾ inches. Pages, 45. Illustrations, 23. New York, 1919: H. F. J. Porter, M. E., 200 Fifth avenue.

At the meeting of the Society of Naval Architects and Marine Engineers, held in Philadelphia on November 14, 1918, the first paper, entitled "The Delamater Iron Works: The Cradle of the Modern Navy," was presented by H. F. J. Porter, M. E., who spent four years at this historical plant after leaving college in 1878. Mr. Porter has consented to issue a limited edition of the paper in the form outlined above.

The paper recounts the history of the Delamater Iron Works from the time it started as the Phœnix Foundry on West street between Vestry and Eighth streets, New York, under James Cunningham in 1838. The plant was taken over by Peter Hogg and Cornelius H. Delamater in 1843. It was moved to the foot of West 38th street in 1850 and was finally closed in 1890. The paper describes the developments which took place at the plant during fifty years under the direction of Mr. Delamater and Captain John Ericsson.

Marine Gas Engines: Their Construction and Management. Second edition. Carl H. Clark, S. B. Size, 5 inches by 7⅜ inches. Pages, 136. Illustrations, 102. New York, 1919: D. Van Nostrand Company. Price, $2.

This book describes briefly the construction and principles of operation of the standard types of marine gas engines, with a special chapter on oil and Diesel engines.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Amount of Pressure

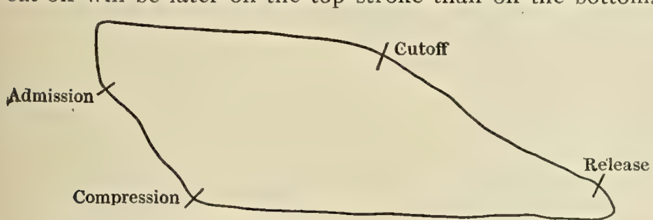
Q. (1006).—What is meant by the pressure on condenser will be 70 atmospheres when machine is fully charged? I do not know what is meant by so many atmospheres. Please explain.

A. (1006).—The barometer under standard conditions will be 30.9 inches, which is equivalent to 14.7 pounds per square inch. Consequently, if the pressure of one atmosphere is 14.7 pounds per square inch, then 70 atmospheres will represent 70 × 14.7, or 1,029 pounds per square inch.

Point of Cut-Off

Q. (1007).—How do you know the point of cut-off on an indicator diagram? What is a common value for the cut-off of a marine engine?

A. (1007).—The point of cut-off on the indicator diagram is often hard to locate, and especially so with many vertical marine engines where the revolutions are fairly high, the valves slow-acting and of small travel. The point of cut-off is usually taken where the outline of diagram changes from convex to concave. The diagram indicates the points at which the various events begin. Due to the angularity of the connecting rod, the point of cut-off will be later on the top stroke than on the bottom.



Position of Events on Indicator Card

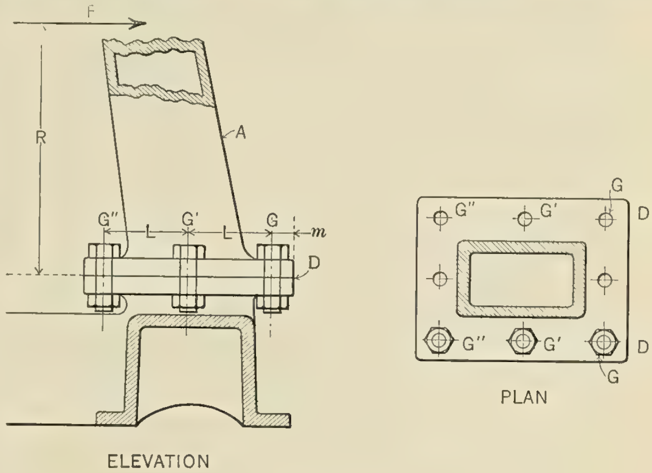
Marine engine practice employs a cut-off at from 50 percent to 80 percent of the stroke, the smaller value being used where economy is all-important, as in cargo vessels (although many merchant ships have a 70-percent cut-off), and the larger value where space and weight must be saved, as in naval practice.

Stress in Column Bolts

Q. (1010).—Under the force F which causes a moment about the corner D, what would be the tensile stress in each of the bolts G, if the distance between them and to the point D were known? A is the guide column of the engine attached to the bedplate by column bolts G. The force F is that exerted by the connecting rod.

A. (1010).—Your question does not mention the fact that we need to know the distance R between the line of action of force F and the column seat. A problem similar to this often arises in the design of riveted joints. It is customary, and it makes the work simpler, to take moments about G, the outer row of bolts, rather than D. Theoretically, however, we should take D as moment axis. Below we shall indicate both methods.

We may consider that the tension in each bolt is proportional to the distance from the moment axis D in the first instance. Then if P represents the tension in each of the bolts marked G'', and since the moment of F about



Sketch of Column Connections

D must equal the sum of the bolt moments about the same, we shall have, taking moments about D,

$$FR = 3P\ (2L + m) + \frac{2P\ (L + m)^2}{2L + m} + \frac{3P\ (m)^2}{2L + m}; \quad (1)$$

or, similarly, taking moment about the outer line of bolts,

$$FR = 3P\ (2L) + \frac{2P\ (L)^2}{2L}. \quad (2)$$

NOTE.—In equation (1) the second term of the right-hand member is obtained when we remember that $\frac{P\ (L + m)}{2L + m}$ represents the pull of one bolt G' in row $G'G'$; its moment about DD will, of course, be $\frac{P\ (L + m)^2}{2L + m}$.

The second equation in this case will give a value of P about 10 percent higher than the first. In this particular problem it should be realized that all large engines will have a column on the other side of the cylinder, which would be capable of taking tension and thus reduce the stress in the column foot. Furthermore, we have not considered the tensile stress in bolts due to steam pressure and acceleration of reciprocating parts, or the shearing stress, all of which should be taken into account. The above method is of more value in design work when forces are better known.

Make-Up Feed Water

Q. (1009).—Although I have looked over many marine texts on engines, I have not found any reference as to how and where the make-up feed is fed into the boiler feed water while the main engines are in operation.
STUDENT.

A. (1009).—A common plan is to run a small pipe from the steam side of the condenser to the feed water tank in the double bottom. The vacuum is sufficient to draw the water into the condenser, and from thence into the feed line.

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

DIRECTORS APPROVE SALE OF BRITISH SHIPS OF THE INTERNATIONAL MERCANTILE MARINE

80 Ships Totaling 763,837 Gross Tons—Olympic and Others Included in Deal

On May 20 the board of directors of the International Mercantile Marine Company, 9 Broadway, New York, approved the sale of vessels and assets of the British companies subsidiary to the company, at a price of approximately $130,000,000 (£27,000,000). This action is regarded as closing the biggest deal in American shipping history, since the approval of the stockholders at a special meeting to be held June 16, it is believed, will naturally follow. The release of this huge sum for the operation of strictly American shipping opens up vast possibilities for the future of the American merchant marine.

The cash and assets of the British companies, which include the Oceanic Steam Navigation Company, Ltd. (The White Star Line), which operates 21 vessels totaling 334,307 gross tons, including the *Olympic, Adriatic* and other large passenger vessels, The Atlantic Transport Company, Ltd., Frederick Leyland Company, Ltd., International Navigation Company, Ltd., British & North Atlantic Steam Navigation, Ltd., and Shaw, Savil & Albion Company, Ltd., total $60,000,000, including securities in other concerns, war bonds, etc. The amount, therefore, to be paid for the ships is only $70,000,000, or less than $100 per ton.

Ships in Poor Condition

Although this rate seems low when compared with present prices, it should be taken into account that all these vessels have received unusually hard usage during the war, have not been kept in repair, and hence could not be considered in first-class condition. To this should be added the fact that 32 of the vessels were built before the present century, and 23 only have been constructed since 1910. The *Olympic*, of 46,359 gross tons, the 24,541-ton *Adriatic*, the 24,547-ton *Belgic* and the 23,876-ton *Baltic*, are the types of vessels which the American merchant marine will have to replace if the same trade routes are to be developed. On the other hand many of the vessels range from 3,013 gross tons up, and can be easily supplied by American shipyard facilities.

Stripped of the British tonnage the International Mercantile Marine will hold only 11 vessels of 130,641 gross tons. Among these are included the 13,639-ton *Manchuria*, the 20,718-ton *Minnesota*, and the 13,639-ton *Mongolia* of the Atlantic Transport Line, and the *Finland, Kroonland, Philadelphia, St. Louis* and *St. Paul* of the American line.

CONTRACT LET FOR $3,000,000 REPAIR SHIP

Puget Sound Yard Will Build Modern Type Repair Vessel

Word has been received from Capt. R. Stocker, U. S. N., head of the designing department of the Bureau of Construction and Repair, Navy Department, of the letting of the contract to the Puget Sound Navy Yard, Bremerton, Wash., for the building of repair ship No. 1 at an estimated cost of $3,000,000.

The vessel will be capable of taking care of all the ordinary repairs of vessels of the fleet, including battleships and battle cruisers. The repair plant which will be installed on board consists of a machine shop, brass and iron foundry, boiler and blacksmith shop, coppersmith shop, pipe and sheet metal shop, pattern and carpenter shop, electrical shop, drafting room, optical shop and gyro testing room.

The repair ship, which is 484 feet long overall, with a beam of 70 feet and a draft of 19 feet, displacing about 10,000 tons, will carry a battery of four 5-inch guns and two 3-inch anti-aircraft guns. The ship will be propelled by steam turbines operating through reduction gearing. It is designed for a speed of 16 knots, and will be equipped with a high-power radio outfit.

Canadian Yard Receives Contract for Three 6,500-Ton Vessels

The National Shipbuilding Company, 42 Broadway, New York, has a contract to build three 6,500-ton steamships for French owners. It is understood that the ships will be built in this company's yard at Three Rivers, Canada.

Newburgh Shipyards Will Build Freight Steamers

The Newburgh Shipyards, Inc., Newburgh, N. Y., is understood to have received a contract to build a freight steamer for the Union Sulphur Company, 17 Battery Place, New York.

MERCHANT MARINE CONFERENCE FAVORS PRIVATE CONTROL OF SHIPPING

Franklin Urges Definite, Permanent Plan to Reassure Ship Operators

At the conference which was held in Washington on May 21-23 between Chairman Hurley of the United States Shipping Board and men representing shipping, commercial and agricultural interests throughout the country, the development of the operation of the American merchant marine by private initiative and capital was recommended in almost every case.

John L. Hamilton, of the American Bankers' Association; Welding Ring, of the New York Chamber of Commerce; N. M. Leach, of the Mississippi Valley Association, and E. P. Thomas, of the Foreign Trade Council, declared against government ownership and operation. Almost the only dissenting vote was expressed by B. F. Marsh, of the Farmers' National Council, who declared that ships "constructed at the government expense should remain the property of the people of the country."

In discussing the question of ship operation, P. A. S. Franklin, president of the International Mercantile, said:

It is not a question of only manufacturing ships, it is a question of building up individual corporations, banking facilities, sales departments in foreign countries, and other things necessary to enable the traffic to be handled properly. I think it is exceedingly important, and we have given this matter a great deal of consideration, and feel that the steel steamers should be sold to private corporations and private individuals and should be operated absolutely as private property and not by the government in any way, shape or form.

We also feel very strongly that a very comprehensive policy should be adopted by the Shipping Board and by the government for the prospective buyer of these steamers, so that they may know what the future situation is going to be, and not feel that two years from now we are going to have a different policy, and in that time having government-owned ships competing with the privately owned ships. Without such policy it would be impossible to get people to put their money in the enterprise. They feel that if they would wait two years they will have a better opportunity than to-day.

The necessity for establishing regular trade lines was emphasized by J. H. Rosseter, director of the Division of Operations, who said:

If we should make the mistake of a promiscuous use of this fleet under any random sale or charter and fail to conserve to the nation the present opportunity of building up regular lines, I am afraid that all of our efforts will have gone for naught. Without regularity, without some direction or control, without some control of needless competition, between ourselves and the fierce competition that is coming to us, we are going to fail.

EXTENSIVE SHIP REPAIR FACILITIES BEING DEVELOPED

Twelve New Drydocks Will Be Constructed

Evidence of the increase in American marine operation is indicated by the extensive ship repair facilities which are being developed at the Atlantic and Pacific coasts and along the Gulf. As may be noted in the marine construction section, this month's reports give a concrete idea of this expansion. Drydocks are being or will be constructed at Mobile, New Orleans, Galveston and St. John, New Brunswick. A 4,000-ton marine railway is included in the plans for the $5,000,000 naval base at Cuba and Charleston, S. C., is to have a $3,500,000 drydock.

The shipbuilding companies are not behind in the movement. The Los Angeles Shipbuilding & Dry Dock Company, the Ames Shipbuilding & Dry Dock Company, the Carl Hartman Company, the St. Helens Shipbuilding Company, the Anderson Shipbuilding Company and the Lake Union Dry Dock & Machine Works plan to build drydock facilities. The Government Island Concrete Shipbuilding plant at San Francisco may become a huge shipbuilding repair plant. In addition we find smaller marine railways being built at the Hamme Marine Railway and the government repair plant at La Playa, Cal. At a rough estimate these new projects would provide at least 85,500 tons additional ship repair capacity.

ST. LOUIS BIDS FOR TWENTY 8,000-TON VESSELS

Will Be Operated Out of New Orleans to South America and the Orient

Business interests of St. Louis, Mo., represented by the Chamber of Commerce, Jackson Johnson, president, have announced that they are contemplating the purchase of twenty 8,000-ton deadweight vessels from the Shipping Board to handle the river traffic of St. Louis shipped from the port of New Orleans.

From Memphis it was recently announced that Joseph Newburger, chairman of that city's Chamber of Commerce, was preparing plans for the organization of a $1,000,000 corporation of purely Memphis capital, to purchase and operate ships from New Orleans.

Bids on Four Steel Towboats

The United States Engineer Office, 428 Custom House street, St. Louis, Mo., will receive proposals until June 13 for the construction of four steel hull stern-wheel towboats for use on the Upper Mississippi river. Further information will be furnished on application.

PRESIDENT REMOVES BAN ALLOWING SHIPYARDS TO ACCEPT CONTRACTS FOR FOREIGN FLAGS

Chairman Hurley May Reconsider Plan to Cancel Contracts for Two Million Tons of Ships

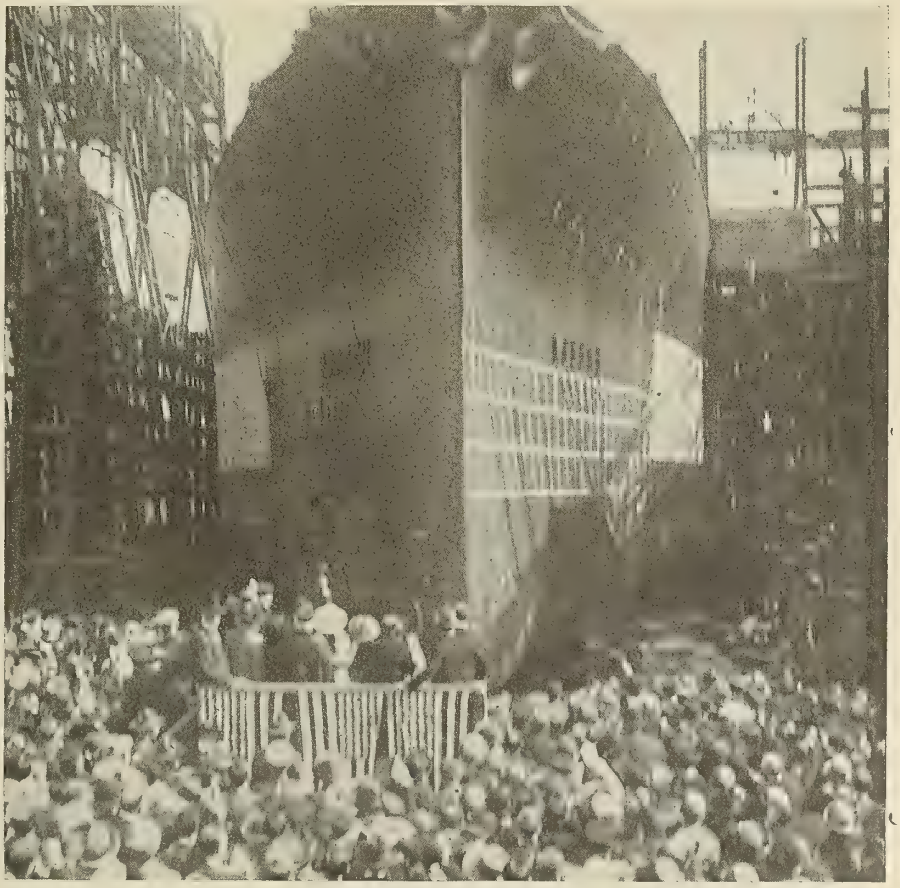
On April 30 Charles Piez made a strong protest, at a dinner given in his honor by the Atlantic Coast Shipbuilders' Association, against the cancellation of contracts for two million tons of shipping, as announced by the Shipping Board and against the ruling which prohibited the shipyards from accepting foreign contracts. Subsequently the leading shipbuilders of the country cabled President Wilson asking him to take immediate action along these lines to improve the shipbuilding situation. Following these moves it was announced from the White House on May 14 that "upon suggestion of Chairman Hurley, of the United States Shipping Board, the President has taken action which will permit American shipyards to accept foreign contracts, so far as that can be done without interfering with the building programme for American register."

ABOUT 3,000,000 GROSS TONS MAY BE BUILT

Possibilities for the placement of foreign contracts with American yards, the chairman said, could be estimated at from 2,500,000 to 3,000,000 gross tons. This is the amount of foreign contracts in sight at present, the chairman said, which might be obtained by the yards of the country if the necessary attractive prices and other inducements could be offered.

There is a strong possibility, the chairman said, that Norway might place with American yards contracts totaling 1,000,000 tons. France, although having already placed contracts totaling 500,000 tons with British yards, contemplates the placement of an additional 500,000 tons, which may be obtained. Italy also is inquiring for the most satisfactory ship offers for the award of steel ship contracts totaling 500,000 tons.

Chairman Hurley declared that although it is expected that a large number of substantial ship contracts probably will be awarded as a result of the President's action in the removing of the foreign ship contract ban, it is not believed that there will be any rush by foreign contractors to place contracts in the United States. Satisfactory prices must be quoted to attract the foreign contracts, he said. The most attractive price offered thus far, the chairman said, was $170 a ton, in the recent sale of shipping to foreign buyers.



(Photograph by Press Illustrating Service)

Battleship *Tennessee*, Launched from the New York Navy Yard on April 30

As an inducement to prospective foreign ship purchasers, Chairman Hurley added, the Shipping Board in all probability will modify its regulations prohibiting the transfer of American-built tonnage to foreign flags to permit the transfer of the foreign-contract tonnage to whatever flag desired. The Shipping Board in a large measure will be governed by the similar regulation of the British Ministry of Shipping.

Large Shipbuilding Plants Already Hold Contracts Which Will Keep Them Busy Through 1919

Interviews with officials of several large shipbuilding companies have shown that some of these yards will not be open to take on new contracts through 1919. The New York Shipbuilding Corporation, for example, holds contracts which will keep it occupied through this period. The shipyard of the William Cramp & Sons Ship & Engine Building Company, which also holds extensive Government contracts, it is reported, could not possibly enter the field in 1919. Henry Carse, president of the Submarine Boat Corporation, stated that the efforts of that company would be concentrated upon producing tonnage for the Emergency Fleet Corporation.

Robert Niles, of the Foundation Company, 233 Broadway, New York, expressed disappointment that the yards had not been permitted to accept contracts immediately after the signing of the armistice, when he considered conditions more favorable than at present.

Government Shipbuilding Programme Necessary

Harrison Robinson, secretary of the California Shipbuilders' Committee, made the following statement regarding the new ruling: "The Government has forced the shipyards to decline contracts for 3,000,000 tons since the signing of the armistice and foreign business has been educated to go elsewhere. Again, it would be six months before we could start business on such contracts, and we are faced by an emergency which we must meet at once, the presentation of the domestic programme."

Hurley Explains Cancellations

In explanation of the announcement that the Shipping Board expected to cancel 2,000,000 tons of ship contracts, Chairman Hurley issued a statement showing that these cancellations seemed advisable in order that the American merchant marine may be so balanced that it can operate in world commerce profitably. He advocated the building of larger vessels and passenger liners.

Before leaving for Chicago Charles Piez, former director-general of the Emergency Fleet Corporation, gave it out that Chairman Hurley had abandoned his policy of scuttling large contracts, as announced previously.

Commander J. L. Ackerson, assistant to Chairman Hurley, has announced that an appropriation of over $600,000,000 by the end of June will be needed to continue the shipbuilding programme.

Record in Refitting Transport Vessels

The American Standard Ship Fittings Corporation, 115 Broadway, New York city, which entered the field of refitting vessels for army transport service during the last of January, 1919, has completed the refitting of the *Minnesotan, Soshone, General Gorgas* and the *South Bend,* at a cost of approximately $750,000. This work has been carried out in less than three months' time.

The work on the *South Bend,* which was under contract to be completed within eighteen days, involved the transformation of housing quarters, as well as additional work on boilers and engines amounting to approximately $200,000.

Twelve Piers for Staten Island

The sinking fund committee of the New York Board of Estimate has voted to endorse the resolution authorizing the city to acquire 8,900 linear feet of water front at Staten Island. An appropriation of $3,000,000 was made as a preliminary instalment.

The water front, which runs from the foot of Marietta street, Tompkinsville, to the Pouch Terminal at the foot of Edgewater street, Rosebank, will be used for the terminals, warehouses and the installation of other terminal facilities. It is planned to build twelve piers on this site; each pier will be 125 feet wide and 1,000 feet long, with a water space of 300 feet between piers. The depth of water at the piers will be dredged to 44 feet. The work will cost at least $10,000,000.

Schwab Will Spend Millions on Sparrow's Point Plant

Charles M. Schwab, of the Bethlehem Steel Corporation, Bethlehem, Pa., announced in Baltimore on May 20 that he would spend between $25,000,000 and $40,000,000 in improvements at the Sparrow's Point plant. This will be in addition to the $50,000,000 improvements now being completed. The adding of ten ships to the present ore fleet of the corporation is among the improvements for which the appropriation will be made.

$5,000,000 New Navy Yard for Cuban Government

The Cuban Government is to build a new $5,000,000 navy yard at Triscornia, Havana harbor. All plans for this modern storage and repair base are in the hands of Monks & Johnson, architects and engineers, 78 Devonshire street, Boston, who planned and supervised the construction of the Victory plant at Squantum, Mass., and other large plants for the United States Government. The new Cuban navy yard is to include three marine railways, storehouses, machine shop, foundry, forge shop and barracks. The shops will have full crane service and up-to-date equipment. Details and engineering information on this project are not yet available.

SHIPYARDS TO CONTRACT WITH THE SHIPPING BOARD AT FLAT PRICE

Elimination of Cost-Plus Basis May Work a Hardship Upon Companies With Insufficient Financial Backing.

Revision of the Shipping Board building programme to a peace basis has been placed before representatives of the Atlantic Gulf and Lake yards by the Shipping Board in recent conferences. The builders were asked if they were prepared to accept flat prices in lieu of the cost-plus basis in use during the war. Where keels have not yet been laid the Board expects generous co-operation from the yards to lower prices to a normal level. It is reported that nearly $700,000,000 additional appropriation will be needed to carry out contracts which the Board has already been authorized to make.

Plan $60,000,000 Terminal Project Off New Jersey Coast

The Lord Construction Company, New York, has made a proposition to the New Jersey State Board of Commerce and Navigation, of which J. Spencer Smith is chairman, for the construction of a huge terminal on Robbins' Reef, in New York harbor.

By means of a fill it would be possible to reclaim 370 acres of land one mile off the Bayonne shore. The construction work, which would be carried on by a new concern to be known as the Jersey Dock and Terminal Company, would include the building of two huge railway trestles connecting the island to the mainland. The island itself would be equipped with piers and warehouses of the latest design.

$5,000,000 for Savannah Harbor

A project is on foot to spend $5,000,000 for the further development of Savannah harbor. The plan includes the building of two piers with adjacent warehouses. If the present plans are accepted by the City Council these piers will be built 1,500 feet in length of fireproof, durable construction.

Plan to Improve Milwaukee Harbor

With the retaining of H. McL. Harding as consulting engineer and supervisor in charge of the construction of the proposed municipal docks and piers at Milwaukee, Wis., actual plans are being laid for the harbor development.

As outlined by Mr. McL. Harding, the first improvement will be the building of a concrete capped retaining wall. The construction will be carried on in sections of, say, 650 feet at a time. Tracks for gantry cranes, a warehouse and railroad tracks on the other side of the warehouse will be built for each unit.

Atlas Steam Soot Blower

Albert T. Otto & Sons, of 101 Park avenue, New York, have taken the American license for the British "improved diamond steam flue blower (front end type) for Scotch boilers, and are manufacturing this apparatus under the name of the Atlas steam soot blower.

The operation, which is extremely simple, consuming from one and one-half to two minutes, consists of opening the outside steam valve, turning the handle of the blower to the right until checked by stop, and then reverse. As the rotating double nozzle is advanced and returned through the combustion chamber, two jets of dry steam are forced against the tube bank and through the tubes in the natural direction of the draft of the boiler. There is no encumbrance whatever on the smokebox door, as the operating handle is quickly detachable and the door readily opened at any time.

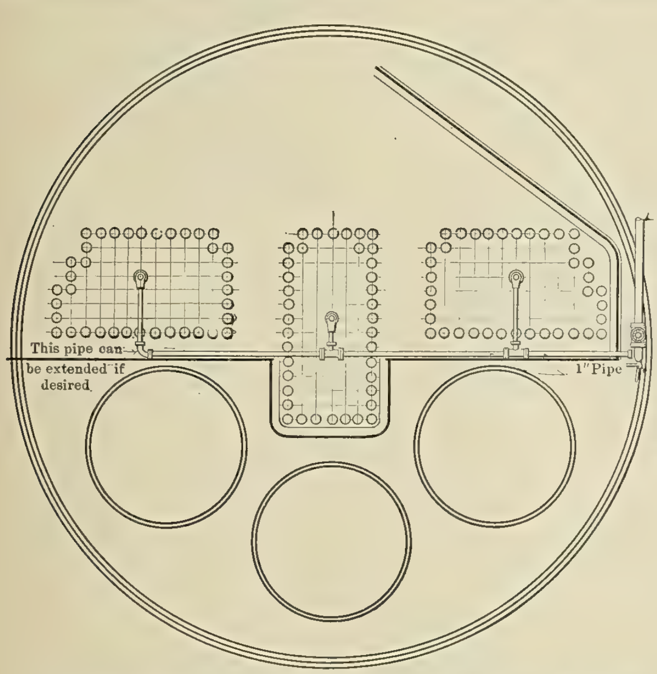
The illustration shows an Atlas installation on a three-furnace boiler. As may be noted, there is one main outside steam valve. Each blower is fitted with an interior valve, which opens and closes automatically by the motion of the handle.

When not in use the blower is telescoped into the tube, which is sealed, out of contact with extreme heat. The use is so short and the results so instantaneous that there is no loss of pressure. The rear plates are cleaned as thoroughly as the tubes, and the blower can be used as often as wished. Hand cleaning is therefore done away with.

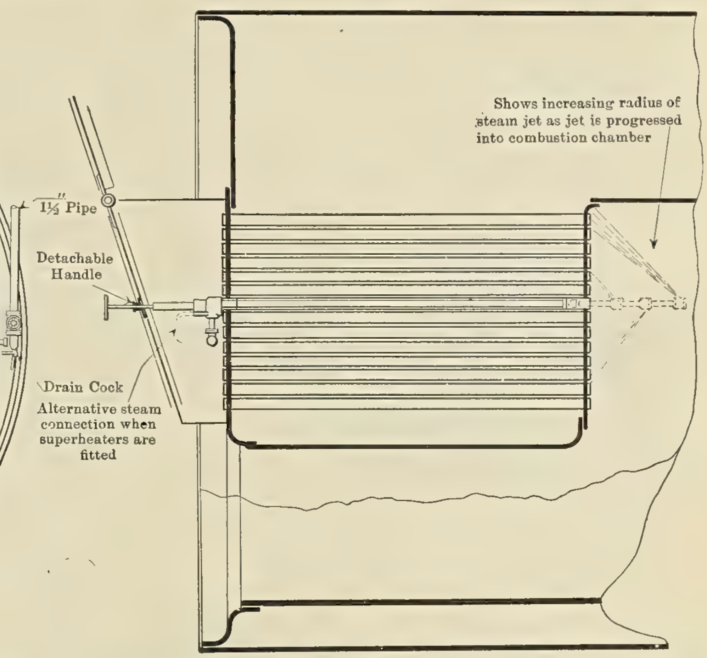
The manufacturers claim that the blower is good for the life of the boiler, and that there has never been a call for a spare part. One of its advantages is its ease of installation—it is just an ordinary job of steam connecting and can be done under pressure. It is practically fool proof; is never in the way and always ready for use.

After exhaustive tests the British Admiralty has adopted this blower to the exclusion of all other makes, and it is used by practically every British steamship line and shipbuilder. The Cunard Line has ordered in the past month over 450 additional blowers. Official tests have shown a saving of 10 percent and over in coal and an increase in the speed of the vessel.

The following extract of a letter from Mr. Charles F. Lumb, head of the English concern, is of interest in connection with the use of superheaters on marine boilers, as illustrating the *necessity of a blower with superheaters:*



Showing Front View of Installation on Three Nests of Tubes. One Steam Valve Controls All Blowers in Box. Each Blower Has Interior Valve Operated Automatically by the Motion of the Handle



By Turning Handle the Rotating Double Jet of Dry Steam Is Advanced Into Combustion Chamber, Thoroughly Cleaning Every Tube Beginning with the Center, and Repeating as It Is Returned to Its Housing.

"One trawler, belonging to Mr. Bascomb, of Grimsby, was equipped with the ——— superheater without the blower. She had gone about thirty miles up the coast when she had to put into port, and the captain telegraphed through that she was unable to make steam. They had to remove the heater, and after the completion of the voyage she was brought back to Grimsby. The superheater was again installed, together with our blowers, and the vessel then succeeded, according to the owner, in reducing her coal consumption by 20 percent.

"Of course, we do not claim the benefit of this altogether to the blower—there is no doubt that the superheater had an important part—but they were useless until the elements were kept clean."

Steam Engines for Auxiliary Schooners

The following information, received from the Talbot Engineering Corporation, 66 Broadway, New York city, emphasizes the possibility of the use of steam engines where weight and space are important factors.

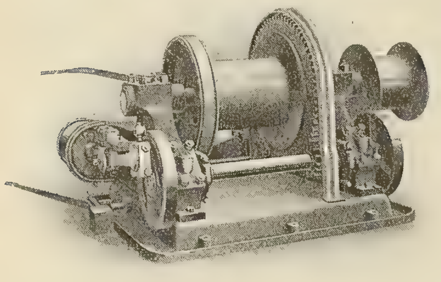
On auxiliary schooners and self-propelled barges it has usually been found unadvisable to use steam engines on account of their bulk. The Talbot boiler, which overcomes this objection, is suited to any grade of fuel from kerosene (paraffin) to thick Mexican oil. The latest Talbot boiler is also fitted for using coal and other solid fuels. The company reports that the same quantity of these cheap grades of fuel is used in the Talbot boiler as would be required to operate ordinary gas engines by the use of gasoline (petrol).

Tests on the steamers where Talbot boilers are installed show a fuel consumption of between one-half and three-quarters of a pound of crude oil per shaft-horsepower. The cost of operation of a Talbot power plant, the company reports, is about 10 to 20 percent of the cost of operation of an ordinary gas engine, and is cheaper than the operation of crude oil engines on account of the inexpensive fuel which can be used. Even in the smaller units, the thermal efficiency is higher than that obtained in large electric power plants, due to the high-pressure superheated steam used. The Talbot Engineering Corporation claims that the Talbot boiler is unusually safe in operation because there are no large steam spaces.

Quick-Acting Ship Winch

The quick-acting ship winch, manufactured by the American Clay Machinery Company, Bucyrus, Ohio, is of the single-drum, single-geared and double-cylinder type, with cylinders 9 inches in diameter by 9-inch stroke. The steam valves are of the piston type. The cylin-

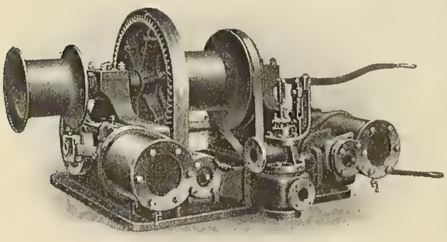
der and steam chest are bored simultaneously to insure accurate alinement. The winch is controlled by a piston reverse valve operated by a hand lever, so conveniently located that it is possible



Front View

for one man to handle two machines at the same time. The valve is provided with a removable bronze liner to prevent sticking.

The gearing is machine molded, ratio of five to one. The drum is 16 inches in diameter, 20 inches long between flanges, and is bolted to a finished surface on the side of the gear, which is keyed to the



Rear View

shaft. The drum is also provided with a friction band brake, lined with Erbestos, thereby, it is claimed, securing perfect control by a slight pressure on the foot lever. The gears are effectively guarded.

The winch head is 14 inches in diameter by 15 inches long, with flanges 21 inches in diameter. The side frames have extra long bearings and are securely bolted to the base plate.

Stationary Electric Riveter

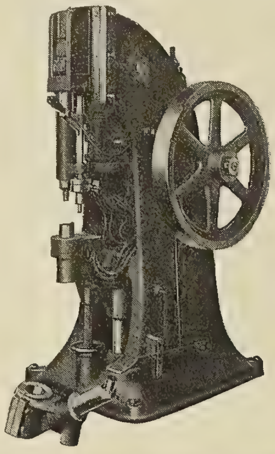
The Thomson electric riveting machines, which are being placed on the market by the Thomson Electric Welding Company, Lynn, Mass., embrace two distinct units within the frame of the machine, one an electrical unit for heating the rivet after it has been set into place, the other a mechanical unit for heading. These two units operate entirely independently of each other, and are so arranged that they require a minimum amount of space in the frame of the machine. One operator can handle both operations.

Most machines arranged for heating rivets by means of an attached transformer have proved unsuccessful because of the dies used. In cases where steel was employed in order to supply material of sufficient strength to stand up under the pressure of heading the rivet, these dies were found to be poor conductors of electricity. On the other hand, if copper was used, the dies were found to lack strength. To overcome these difficulties the Thomson electric riveters are constructed with two separate upper dies mounted on a sliding head, so as first to utilize a copper electrode in contact with the rivet shank, in order to produce the proper heating effect, and then to employ a steel die to head the rivet by one stroke of the power-driven press.

The actual heating time on a ¾-inch rivet through two ½-inch plates is recorded as 15 seconds. On a production basis, therefore, it is possible to drive 125 rivets of this size in an hour on small structural steel assembly parts. Based on average power rates the electricity used costs only about 5 cents. With this machine electrical energy and mechanical power are utilized only during actual heating and heading. In the stationary riveter illustrated, the upper copper die and the lower steel die holder are both water-cooled. All play that may develop in the vertical slide of the press action may be taken up by a gib with three adjustment screws.

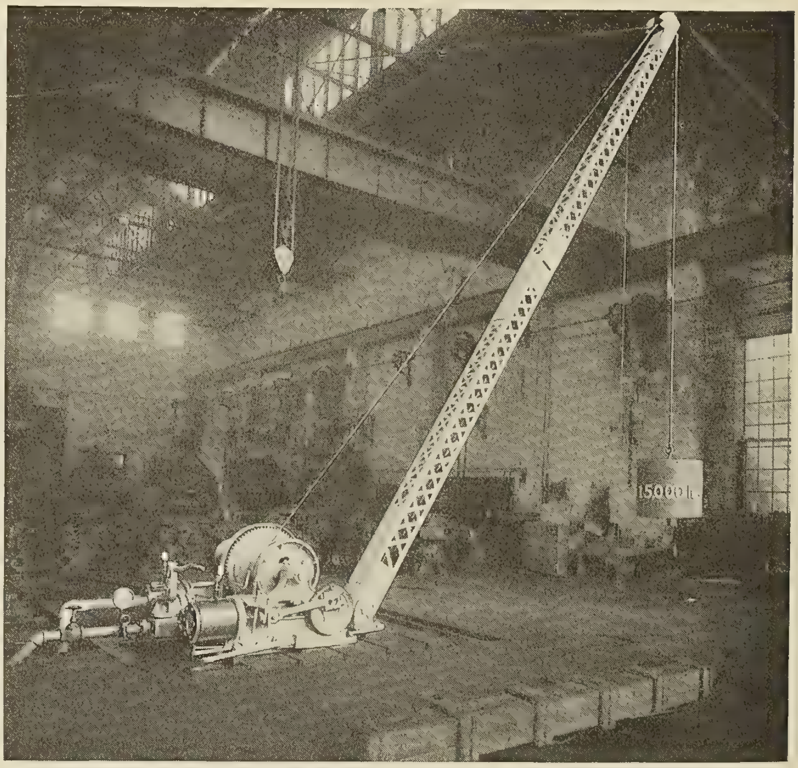
In operation the rivet is heated with the copper die until the shank has reached nearly white heat. The operator then swings the sliding head to the right, bringing the steel heading die in line directly over the hot rivet. By the depression of the foot treadle, the heading die makes one full down-stroke, completely heading the rivet. To provide against premature depression of the foot treadle, the sliding head is provided with a tongue protruding from the rear of its vertical fulcrum, which, through a bell-crank connected to the clutch-operating mechanism, blocks the downward stroke of the foot treadle unless the steel heading die is squarely over the center of the lower die.

An enclosed regulator switch is provided to regulate the secondary voltage



Type C Stationary Electric Riveter

to suit the various sizes of rivets being handled by the machine. The transformer of this machine can be wound for 220, 440 or 550 volts, 50-to 60-cycle, single-phase alternating current only. Special windings are furnished for an odd voltage, or the transformer can be built to operate on frequencies from 25 to 40 cycles, if desired. To meet the demand for a horn with more clearance, a special lower horn, shown detached at the foot of the machine, can be supplied.



Testing Ship Winch at Factory of American Clay Machinery Company

Marine Construction News of the Month

Ships, Shipyards and Shipyard Improvements—Terminal Projects—Launchings—Government Contracts

NEWS OF SHIP CONTRACTS

The Clinton Shipbuilding & Repair Company, Philadelphia, Pa., is building a wooden tug for E. J. Barton, 1 Broadway, New York city.

Downey Shipbuilding Corporation, 5 Nassau street, New York city, has received a contract to build a steel cargo carrier for a private American account.

Haviside, Withers & Davis, San Francisco, Cal., have received a contract for rigging 20 vessels for the Foundation Company. Ships are being constructed for the French Government at Vancouver, B. C.

Hodges Boiler Works Company, Mobile, Ala., is building a steel steam tug, 98 feet between perpendiculars, 107 feet overall, with 21-foot beam, for the Gulf Barge Navigation & Towing Company, New Orleans, La. Latest compound type engines developing 400 horsepower will be installed.

Howard Shipyards & Dock Company, Jeffersonville, Ind., has received a contract for building ten oil barges for river service. Barges will be of wood, 130 by 25 by 7 feet 3 inches, without power; oil will be carried in bulk in the hulls.

R. & W. Hawthorn, Leslie & Company, Hebburn-on-Tyne, England, has received a contract from the Cunard Steamship Company for the building of a large steamer. Engines will be constructed at the St. Peter's works of the firm.

The Kawasaka Dock Yard Company, Japan, it is reported, has received a contract to build three passenger steamers for the Nippon Yusen Kaisha.

Kruse & Banks Shipbuilding Company, North Bend, Ore., has received a contract for building a lumber schooner for a San Francisco company. The vessel will be 240 feet long, 44-foot beam, and have a capacity for 1,000,000 feet of lumber.

Leathem & Smith Towing & Wrecking Company, Sturgeon Bay, Wis., is working on twelve 100-foot tugs for the Shipping Board.

Mitsui Bishi Company, Japan, it is reported, has received a contract to build three passenger steamers for the Nippon Yusen Kaisha.

The National Shipbuilding Company, 42 Broadway, New York, it is reported, has received a contract to build three 6,500-ton steamships for French owners. The ships will probably be built at the Three Rivers yard.

The Newburgh Shipyards, Inc., Newburgh, N. Y., has received a contract to build a freight steamer for the Union Sulphur Company, 17 Battery Place, New York.

The Puget Sound Navy Yard, Bremerton, Wash., has received a contract to build a 484-foot repair ship to cost about $3,000,000.

The United States Shipping Board has decided to build a considerable number of motorships of 8,000 tons deadweight.

NEW SHIPYARDS AND SHIPYARD EXTENSIONS

Blacksmith and Coppersmith Shops, Philadelphia, Pa.—William Cramp & Sons Ship & Engine Building Company, Beach and Ball streets, Philadelphia, Pa., is rebuilding blacksmith and coppersmith shops previously destroyed by fire. Four 15-ton cranes are being installed at the plant.

Boiler Plant, Hampton Roads, Va.—At the Hampton Roads Naval Base, Old Point Comfort, Va., the Navy Department will erect a $280,000 boiler plant. Contract tentatively awarded to Wise & Granite Construction Company, Inc.

Drydock, St. Helen's, Ore. — St. Helen's Shipbuilding Company is planning to build a 5,000-ton capacity drydock, 320 feet long by 90 feet wide.

Drydock, Repair Plant, Seattle, Wash. —The Lake Union Dry Dock & Machine Works plans to erect a 1,000-foot drydock, machine shop and oil station on a $30,000 tract of land on Lake Union. Improvements will cost about $50,000.

Drydock, Charleston, S. C.—At the Charleston Navy Yard, Charleston, S. C., the Navy Department will construct a $3,500,000 drydock, for which bids were closed on May 19. Work involves excavation work, installation of piping, erection of bulkhead, cofferdam and temporary structures, building drydock proper. The latter will consist of 180,000 cubic yards concrete, pump well, suction chamber, railroad tracks, crane tracks, culverts and sluices, with hydraulically-operated valves, keel blocks, bilge blocks, etc.

Drydock, Mobile, Ala.—W. T. Donnelly, 17 Battery Place, New York, will supervise the building of a 10,000-ton drydock. A ship repair plant, including boiler shops, blacksmith shops, machine shops and foundries, will be built in connection with the project.

Drydock, Galveston, Tex.—W. T. Donnelly, 17 Battery Place, New York, will supervise the building of a 10,000-ton drydock. A ship repair plant, including boiler shops, blacksmith shops, machine shops and foundries, will be built in connection with the project.

Drydock, Los Angeles, Cal.—The Los Angeles Shipbuilding & Dry Dock Company, Los Angeles, Cal., began construction on May 7 on a 10,000-ton drydock to cost $2,000,000.

Drydock, New Orleans, La.—W. T. Donnelly, 17 Battery Place, New York, will supervise the building of a 10,000-ton drydock. A ship repair plant, including boiler shops, blacksmith shops, machine shops and foundries, will be built in connection with the project.

Drydock, St. John, N. B.—Carlo Carneile, marine contractor, Montreal, Canada, has received a contract to build a 1,180-foot drydock at St. John, N. B., to be known as the Courtney Bay Drydock.

Drydock, Seattle, Wash.—The Ames Shipbuilding & Dry Dock Company has commenced construction on its six-pontoon drydock of 18,000 tons. C. A. Barron is the purchasing agent.

Drydock, Green Bay, Wis.—Carl Hartmann Company, Green Bay, Wis., has begun construction on the 600-foot concrete drydock. With the exception of keel blocks, reinforced concrete will be used throughout; capacity, 6,000 tons; made in four units, each unit constructed in three sections, 80 by 50 feet. Centralized pumping arrangement; individual pumping units for operation of separate units. Francis H. Early, architect, Chicago, Ill., and E. T. Morrison, Morrison & Beck, Chicago, Ill., are in charge of the work.

Drydock, Perth Amboy, N. J.—The Perth Amboy Dry Dock Company, Perth Amboy, N. J., is repairing and enlarging one of its drydocks upon which new pumping machinery will be installed.

Machinery and Equipment, Gulfport, Miss.—The International Ship Building Company, Gulfport, Miss., has increased its capital from $200,000 to $1,000,000. The company will enlarge its present plant with additional machinery and equipment.

Marine Railway, La Playa, Cal.—The Danforth Company, Buffalo, N. Y., holds a contract for building a drydock at La Playa, Cal., coaling station to cost $250,000. A well-equipped machine shop will be constructed.

Marine Railway, Wilmington, N. C.—The Hamme Marine Railway, 106 North Fourth street, Wilmington, N. C., R. F. Hamme president, will construct a 500-ton marine railway to cost $15,000 on a 100-foot waterfront. Electrical machinery will be installed.

Naval Base, Havana, Cuba—Capt. Sidney Henry, United States naval engineer, has submitted plans to President Menocal, Cuba, for the erection of a naval shipyard on site opposite the capital. Plans include three marine railways and two concrete piers, etc. Monks & Johnson, 78 Devonshire street, Boston, has received the contract to build the naval base at an estimated cost of $5,000,000.

Ship Repair Plant, Houghton, Wash.—J. L. Anderson, of the Anderson Shipbuilding Company, has announced that the present Lake Washington yard will be converted into a repair plant. Construction includes new marine railway with capacity of 4,000 to 5,000 tons.

Ship Repair Plant, Lake Washington Canal, Wash.—Olson & Sunde, Lake Washington Canal, Wash., are building a new ship repair plant, including marine ways on Lake Washington Canal; machine shop now completed; work progressing on marine ways. Company will also manufacture marine equipment.

Ship Repair Plant, San Francisco, Cal.—D. A. Dickie, San Francisco, district manager of the United States Shipping Board, proposes using the Government Island concrete shipbuilding plant as a repair base for the merchant fleet. Proposed construction would cost $2,500,000, including the building of a floating drydock at a cost of $1,000,000.

Shipways, Portland, Ore.—The Marine Repair & Construction Company, Portland, Ore., will construct five new ways at the present repair plant to accommodate 200-foot vessels. New repair shops will be built.

Shipyard Extension, New Glasgow, N. S.—The Nova Scotia Shipbuilding Company, New Glasgow, N. S., has extended its shipbuilding plant.

Shipyard, San Diego, Cal.—The San Diego Shipbuilding Company, San Diego, Cal., a newly-organized concern, will build a shipbuilding plant on 17 acres of waterfront. Adam F. Weckler, president and general manager; Adam J. Weckler, treasurer; O. Winfield Wilson, secretary, and O. K. Wilson, vice-president and manager in charge of construction.

Structural Shop, Mare Island, Cal.—Contract has been let to the American Bridge Company, Wilkins building, Washington, D. C., for steel for structural shop to be built at the California Navy Yard. Cost of material, $591,181.

PROPOSED CONSTRUCTION

Dredging, New Haven, Conn.—The United States Engineer Office, New London, Conn., opened bids on May 20 for dredging at New Haven harbor.

Derrick Boat, Washington, D. C.—The Columbia Granite & Dredging Company, 3036 K street, N. W., Washington, D. C., is in the market for a derrick-boat to operate a clam-shell bucket for unloading sand and crushed stone.

Elevator Shaft, Philadelphia, Pa.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has invited bids for the building of an elevator shaft in the heavy machine shop at Philadelphia, Pa. Estimated cost $14,000.

Fill, Astoria, Ore.—New bids have been asked for making the fill in Astoria's third reclamation district. Estimated cost of work $257,000. R. R. Bartlett, city engineer.

Fireboat, Norfolk, Va.—Charles S. McLean, 412 Citizens Bank building, Norfolk, Va., is in the market for a fireboat.

Freight Shed, Astoria, Ore.—Bids were opened on April 29 for the building of a freight shed on Pier 1, 312 feet long and 92 feet wide. R. R. Bartlett, city engineer.

Harbor Improvements, Los Angeles, Cal.—The city of Los Angeles, Cal., has voted to spend $1,500,000 for harbor improvements.

Jetty and Revetment, Miami, Fla.—United States Engineer Office, Jacksonville, Fla., has opened proposals for a jetty and revetment construction in Miami harbor.

Lock and Dam, Cincinnati, Ohio—Capt. R. R. Jones, engineer in charge of Cincinnati District No. 1, has received a bid from the Dravo Contracting Company, Pittsburgh, Pa., for the construction of lock and dam No. 32 at the cost of $1,251,680.05.

Lumber Assembling Dock, Vancouver, B. C.—The Dominion Government, Ottawa, is preparing plans through the Department of Public Works, Ottawa, for a lumber assembling dock. The project will cost about $1,000,000.

Oil-Loading Docks, Freeport, Tex.—The Gulf Pipe Line Company, Freeport, Tex., is planning to operate oil-loading docks on a 333-foot waterfront.

Oil Storage Warehouses, Boston, Philadelphia, Galveston, Colon and Cristobal.—The United States Shipping Board plans the building of oil storage facilities at these ports to cost about $5,000,000.

Piers, Hoboken, N. J.—It is proposed to rebuild wooden Piers 6 and 3, recently purchased by the Government, with a third pier at the cost of $2,500,000. Construction to be modern, double-deck concrete and steel.

Pier and Freight Shed, Astoria, Ore.—Bids will be advertised about June 1 for building of reinforced concrete pier and freight shed at Astoria, Ore., to cost about $800,000. The shed will have reinforced concrete walls and concrete and bitulithic floors, will be 1,500 feet long and 160 feet wide, and be equipped with sprinkler system, cargo cranes, electric tractors and freight-handling apparatus. R. R. Bartlett, city engineer.

Piers, Milwaukee, Wis.—Under supervision of H. McL. Harding, the city of Milwaukee is planning the construction of municipal docks and piers. Concrete capped retaining wall will be built. Improvements include tracks for gantry cranes, a warehouse for each section, railroad tracks, etc.

Piers, Warehouses, Savannah, Ga.—The city proposes to build two piers, 1,500 feet in length, of fireproof, durable construction, with adjacent warehouses. Project will cost about $5,000,000.

Piers, Staten Island, N. Y.—The sinking fund committee of the New York Board of Estimate has voted to endorse the resolution authorizing the city to acquire 8,900 linear feet of waterfront at Staten Island. A preliminary appropriation of $3,000,000 was granted. Construction will include twelve piers, 1,000 feet long by 125 wide, with a water space of 300 feet between piers. Depth of water at piers will be dredged to 44 feet. Estimated cost $10,000,000.

Pleasure Pier, Redondo Beach, Cal.—The city of Rendondo Beach, Cal., has voted on bond for $40,000 for building a reinforced concrete pleasure pier. Leeds & Barnard, Los Angeles, Cal., are the engineers.

Ship Coaling Dock, New Orleans, La.—J. D. O'Reilly, chief engineer of the Dock Board, New Orleans, La., is preparing plans for a $390,000 ship coaling dock on a 1,200-foot waterfront. Project includes an 85- by 580-foot storage shed, with a capacity of 25,000 tons and a wharf 300 by 40 feet. A conveyor system, a 50-foot wharf tower, a 50-ton hopper, a stiff-leg derrick, derrick track hopper, 35 by 50 feet, bucket elevator, with a capacity of 200 tons hourly, self-recording and automatic scales, loading devices, etc., are to be installed.

Terminal Sales Building, London, England—Irving T. Bush, president of the Bush Terminal Company, New York, it is reported, is arranging for the construction of a large terminal sales building in London.

Timber Wharf—A. E. Foreman, Victoria engineer, Victoria, B. C., is soliciting bids for a timber wharf to be built at Prince Rupert, B. C., to cost about $47,200.

Wharf, Buena Ventura, Colombia, S. A.—The Departmento del Valle of the Republic of Colombia, S. A., has obtained a credit for $1,000,000, which will be used for the construction of a wharf at Buena Ventura, an important Colombian port on the Pacific coast.

Wharf, Seattle, Wash.—Mitsui & Company, San Francisco, Cal., is preparing to construct a 1,000-foot wharf at Seattle; also large tanks and a seven-story warehouse for storage of Oriental vegetable oils.

Wharf and Oil Station, Empire, Ore.—James S. Polhemus, United States Engineer Office, Portland, Ore., has completed plans for the construction of a 200-foot wharf and oil station to cost about $50,000 at Empire, Ore.

Watertank and Tower, Hampton Roads, Va.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is planning to build a steel watertank and tower at Hampton Roads, Va., to cost about $25,000.

CONTRACTS LET FOR HARBOR IMPROVEMENTS

Dock, Astoria, Ore.—The Portland Bridge & Building Company, Portland, Ore., is constructing a 200- by 40-foot dock for the Standard Oil Company. Contracts for pump house, storage tanks, offices and warehouses have not been let.

Dredging, Tillamook, Ore.—The Tillamook Port Commission, Tillamook, Ore., has let a contract to the Tacoma Dredging Company, Tacoma, Wash., for removing 1,000,000 cubic yards of material to provide a mean harbor depth of 20 feet.

Power Plant Improvements, Naval Aviation Air Station, Pensacola, Fla.—Contract has been let by the Bureau of Yards and Docks, Navy Department, Washington, D. C., to the Carroll Electric Company, 714 Twelfth street, Washington, D. C., for $54,500.

Pier, Portland, Ore.—Contract has been awarded to Elliott & Scoggins for construction of a 300-foot addition to Pier No. 1 at St. John's Terminal and construction of wharf of Pier No. 2, to cost $329,279.20.

Warehouses, Port Clinton, Ohio—Cleveland Construction Company, Citizens building, Cleveland, Ohio, has received a contract to build warehouses at Port Clinton, Ohio.

EQUIPMENT

Boilers, Portland, Ore.—The Willamette Iron & Steel Company, Portland, Ore., has received a contract to furnish four boilers for 8,800-ton steamers being built by the Emergency Fleet Corporation in Shanghai, China, also orders for twelve boilers from the Robert Dollar Steamship Company.

Cranes, Charleston, W. Va.—The Bureau of Yards and Docks, Navy Department, Washington, has opened bids on twenty-two cranes to be installed at the naval ordnance plant. Requirements are as follows: One 250-ton, two 200-ton, one 125-ton, two 100-ton, one 75-ton, one 25-ton, two 15-ton; also two 250-ton and one 75-ton for use in connection with hydraulic presses, as well as eight 75-ton and one 150-ton, to be used in the machine shop and heat treatment department. About $1,805,000 is involved in the order.

Engine Lathes, Brooklyn, N. Y.—New York Navy Yard will purchase twelve 16-inch engine lathes. Bids received by the Navy Department, Washington, D. C.

Machine Tools, Hog Island, Pa.—The American International Shipbuilding Corporation, Hog Island, Pa., is in the market for 400 tools as follows: One hundred 9-inch or 14-inch shapers, 100 16-inch lathes, 100 20-inch upright drills and 100 10-inch grinders—and 100 electric motors for machine shops on merchant ships.

Machine Tools, Bristol, Pa.—The Merchant Shipbuilding Corporation, Bristol, Pa., is reported to be in the market for thirty sets of machine tools, as per specification under *Machine Tools,* Hog Island.

Propelling Turbines and Reduction Gears—Bids were opened on May 12 by the Purchasing Branch, Supply Division, Emergency Fleet Corporation, 140 North Broad street, Philadelphia, Pa., for furnishing 12,000-horsepower propelling turbines and reduction gears.

RECENT LAUNCHINGS

The Albina Engine & Machine Works, Inc., Portland, Ore., launched the 3,800-ton hull *Glymont* on April 23.

The American International Shipbuilding Corporation, Hog Island, Pa., launched its twenty-second ship, the *Satarita,* a 7,500-ton cargo carrier, on April 12, the *Kisacoquillas* on April 16, the *Schroon* on April 23, and the twenty-fifth ship on April 25.

The Ames Shipbuilding & Dry Dock Company, Seattle, Wash., launched another steel ship, the *West Islay,* on April 26, for the United States Shipping Board.

The Bethlehem Shipbuilding Corporation, Bethlehem, Pa., has recently launched the following ships: (Fore River) the destroyer *Morris* on April 12, the Submarine R-3 on April 17, the destroyer *Tingey* on April 24, and the steamer *Andria Luckenbach* for the Luckenbach Steamship Company on May 3; (Potrero) the 10,100-ton tanker *Dorches,* the destroyer Howard on April 25, and the destroyer *Nicholas,* on April 12.

The Boston Navy Yard, Boston, Mass., launched the oil carrier *Brazos* of 14,500 tons on May 1.

The Brunswick Shipbuilding Company, Brunswick, Ga., launched the schooner *Eleanor Taylor* on April 30.

The Coast Shipbuilding Company, Portland, Ore., launched the hull of the *Boyton* on April 20.

The Frances Cobb Shipbuilding Company, Rockland, Me., launched the four-masted schooner *Freeman,* which it is building for the Atlantic Coast Company, Boston, on April 3.

The Columbia Shipbuilding Corporation, Portland, Ore., launched the 8,800-ton steamer *West Hargrave* on April 10, the *West Quechee* on April 18, the *West Harlan* on May 3, and the *City of Eureka* on May 8.

The Coos Bay Shipbuilding Company, Marshfield, Ore., has launched the eighth Ferris type vessel, the *Peishewan,* which the company is building for the Government.

The William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., recently launched the torpedo boat destroyer *Southard* and the destroyer *Hovey* on April 26.

The G. G. Deering Company, Bath, Me., launched the 255-foot five-mast schooner *Carroll A. Deering* on April 4.

The J. F. Duthie & Company, Seattle, Wash., launched the 8,800-ton steel ship *West Hematite* on April 26 for the United States Shipping Board.

The Federal Shipbuilding Company, Kearny, N. J., launched its thirteenth steel ship, the *Lorain,* a 9,600-ton vessel, on April 17.

The Fougner Concrete Shipbuilding Company, Inc., Long Island, N. Y., has launched the 3,500-ton concrete ship *Polias.*

The Foundation Company, 233 Broadway, New York, launched its fifteenth vessel on May 3, at the Savannah yards.

The Fulton Shipbuilding Company, Wilmington, Cal., launched the 3,500-ton wooden ship *Woboka* on April 15.

The Gildersleeve Ship Construction Company, Gildersleeve, Conn., has launched the third and last 1,000-ton coal barge which the company is building for the Government. These barges are built at a cost of $35,000 each, and are delivered at the New York Navy Yard, Brooklyn, N. Y.

The Gray's Harbor Motorship Corporation, Aberdeen, Wash., launched the 4,000-ton twin-screw steamer *Gray Cloud* on April 12, building for the Emergency Fleet Corporation.

The Merrill-Stevens Shipbuilding Corporation, Jacksonville, Fla., launched the Emergency Fleet Corporation's vessel *Lone Star* on April 10. The vessel was being repaired at the company's drydock.

The McAteer Ship Building Company, Seattle, Wash., launched the 2,500-ton schooner *Mount Whitney* on April 17.

The Moore Shipbuilding Company, Oakland, Cal., launched two 9,400-ton freighters, the *Nokatay* and *Nockum,* also the 10,000-ton tanker *Miskianza* on April 27.

The J. M. Murdock Shipbuilding Company, Jacksonville, Fla., launched the 3,500-ton Ferris vessel *Fort Lauderdale* on April 10.

The Murnan Shipbuilding Corporation, Mobile, Ala., launched the fourth of twenty barges which the company is building for the Warrior river service on April 22, and two mud scows were launched on April 30.

The National Ship Building Company, Orange, Tex., launched the wooden vessel *Argena* on April 15.

The Newburgh Shipyards, Inc., Newburgh, N. Y., recently launched the 9,000-ton steel freight steamship *Gold Spring.*

The New York Shipbuilding Corporation, Camden, N. J., recently launched the destroyer *Brooks,* and on May 8 launched the destroyer *Herbert.*

The Nicholas Tsu Shipbuilding Works, Shanghai, China, launched the 260-foot vessel *Gweneth* on March 2.

The Nilson & Kelez Shipbuilding Corporation, Seattle, Wash., on April 28, launched the 3,500-ton Ferris type wooden vessel *Cinyras* for the United States Shipping Board.

The Northwest Steel Company, Portland, Ore., launched the 8,800-ton steel vessel *Tripp* on April 23, and the *West Chatala* on May 3.

The Pacific Coast Shipbuilding Company, Suisin Bay, Cal., launched the 9,400-ton deadweight freight steamer *Cockaponset* on May 4. This is the third vessel of that size which has been built at that yard.

The Portland Shipbuilding Company, Portland, Ore., is about ready to launch a powerful sternwheel towboat, to be named the *Portland*, which is being built by the Portland Commission for river and harbor towing.

The St. Helen's Shipbuilding Company, Portland, Ore., launched the barge *Fort Shaw* on April 19.

The St. John's River Shipbuilding Company, South Jacksonville, Fla., has launched the 3,500-ton Ferris type vessel *Fort Pierce*, and is now building three large barges.

Sanderson & Porter, Raymond, Wash., launched the *Kitan* on April 1. The vessel will be outfitted at the Griffith's plant, Winslow.

The Sandy Point Shipbuilding Corporation, Sandy Point, Md., launched the 3,500-ton Ferris vessel, *Waukomis*, on April 12.

The Seaborn Shipyards Company, Tacoma, Wash., launched the 3,500-ton wooden vessel *Chesterfield* on April 17.

The L. H. Shattuck, Inc., Shipyard, Portsmouth, N. H., launched the Ferris type wooden vessel *Sylvanus* on April 14.

The Skinner & Eddy Corporation, Seattle, Wash., launched the 9,600-ton steel ship *Polybius* on April 12, and its thirty-seventh vessel the 9,600-ton *Edgewood* on April 19.

The Sloan Shipyards Corporation, Olympia, Wash., launched the 3,500-ton Ferris type wooden vessel *Hyannis* on April 14 for the Emergency Fleet Corporation.

The Southwestern Shipbuilding Company, San Pedro, Calif., launched the 8,800-ton steel freighter *West Cawthon*, on April 16.

The Standard Shipbuilding Company, Shooters Island, N. Y., launched the 7,500-ton steel cargo ship the *Glenridge* on April 20.

The G. M. Standifer Construction Corporation, Portland, Ore., launched the steamer *Akanaquent* on April 17, and the *Kudapasan* on May 3; (Vancouver, Wash.) the 9,500-ton steamer *Waban* on April 17, and the *Bushrod* on April 28.

The Supple-Ballin Shipbuilding Corporation, Portland, Ore., launched the composite ship *Dertona* on April 10.

The Tacoma Shipbuilding Company, Tacoma, Wash., launched a 3,500-ton steamer, the *Fort Union*, on April 17.

The Texas Steamship Company, Bath, Me., has launched the *Texaco*. The vessel will be used for coastwise service.

The Todd Dry Dock & Construction Corporation, Tacoma, Wash., launched the 7,500-ton steel ship *Remus* on April 16, and the 7,500-ton steamer *Ossining* on May 6.

The Union Construction Company, Oakland, Cal., launched the 9,400-ton *Hatchie* on April 26.

Changes in Shipping Board and Emergency Fleet Corporation

Henry M. Robinson, Pasadena, Cal., has been appointed a member of the Shipping Board to replace Charles R. Page, of San Francisco. Walter S. Reed, treasurer, will succeed George T. Smith; P. J. McAuliffe will succeed Daniel Cox, head of ship construction division; R. E. Talbert will succeed M. D. Ferris, head of contract division; Capt. R. E. Bakenhus, United States Navy, will succeed Admiral H. H. Rousseau, head of the shipyard plants division; M. H. S. Rollason will succeed A. E. Pfeiffer, head of the material supplies department. No reports have been received as to the successors of Gordon Wilson, general auditor, and R. W. Leatherbee, head of the industrial relations division. S. M. Evans, Orange, N. J., will succeed Howard Coonley.

PERSONALS

Homer L. Ferguson, president and general manager of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., has been elected president of the Chamber of Commerce of the United States. Mr. Ferguson has recently been nominated for membership on the Council of the National Merchant Marine Association.

H. McL. Harding has been retained by the city of Milwaukee, Wis., as consulting and supervising engineer, in charge of construction on the proposed municipal docks and freight terminals to be erected on Jones Island.

Lieutenant-Commander G. A. Duncan, Civil Engineer Corps, United States Navy, formerly resident engineer at the Emergency Fleet Corporation's plant at Newark Bay, N. J., is now public works officer in charge of the construction work at the Naval Operating Base situated at Hampton Roads, Va.

L. W. Hertz, formerly with Moore & McCormack Company, is now vice-president and general manager of the National Steamship Lines, Ltd., 11 Broadway, New York city.

E. O. Cutler, vice-president and manager of the Groton Iron Works, Groton, Conn., has resigned from the company so that the receivers will not feel restrained in any of their actions in connection with the conduct of the company. Mr. Cutler still retains his position as vice-president and consulting engineer of the Virginia Shipbuilding Corporation, Alexandria, Va.

H. E. Frick, who has acted as the United States Shipping Board Emergency Fleet Corporation representative at the Hog Island shipyard, has been appointed district manager of the Shipping Board in Seattle, Wash.

T. M. Cornbrooks, who for the past nineteen years has been connected with the Sparrow's Point, Md., plant now operated by the Bethlehem Shipbuilding Corporation, has resigned his position as assistant manager at that yard to take the position of general superintendent of hull construction in the yards of the New York Shipbuilding Corporation, Camden, N. J.

Andrew V. Terek, recently discharged from the Naval Aviation Service, has returned as master mechanic in charge of the up-keep of the factory of the Bantam Ball Bearing Company, Bantam, Conn.

Galin L. Stone, who has acted as president of the Atlantic, Gulf & West Indies Steamship Lines, has been elected chairman of the board, and Alexander R. Nicol, former treasurer of the allied companies, has been elected president.

G. A. Tomlinson has resigned as director of the Inland Waterways and Canals Division, which is under the jurisdiction of the United States Railroad Administration, to become resident director of the London office of the American Shipbuilding Company.

Capt. William Magee, manager of the North Pacific district of the Emergency Fleet Corporation on the retirement of Capt. Blain, has resigned to become connected with the Marine Construction & Repair Plant, Eagle Harbor, Wash.

On May 16, Benjamin G. Lamme, chief engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., was awarded the Edison Medal by the American Institute of Electrical Engineers "for invention and development of machinery."

Oliver P. Caldwell has resigned as vice-president and director of the United States Navigation Company.

Capt. F. W. Cullum, formerly master on the Blue Funnel Lines, Liverpool, England, has joined the organization of Capt. John F. Blain, Seattle, Wash., as marine surveyor.

R. E. McMath has been elected secretary of the Bethlehem Shipbuilding Corporation and the Bethlehem Steel Company, Bethlehem, Pa.

Daniel H. Cox, having resigned his position as manager of the Ship Construction Division of the United States Shipping Board Emergency Fleet Corporation, has resumed his original business with the firm of Cox & Stevens, naval architects, marine engineers and vessel brokers, 15 William street, New York city.

Charles H. Stoddard, who for three years has been chief engineer of the Moore & Scott Iron Works, San Francisco, Cal., has been appointed consulting marine engineer of the Heine Safety Boiler Company, manufacturers of Heine watertube boilers, with plants located at St. Louis, Mo., and Phœnixville, Pa. Mr. Stoddard, who received his technical education at Stamford University, has had extensive experience in the designing of a great variety of machinery and vessels on the Pacific Coast, including boilers of all types, engines, steamers, tugboats, standard wheel and sidewheel river boats, war ships and cargo vessels.

JANUARY, 1919

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BUILD MORE SHIPWAYS AT SPARROWS POINT

Impetus of Permanent Peace Plans Now Stimulates Building in North and South

The Bethlehem Shipbuilding Corporation, Ltd., Sparrows Point, Md., is building three new shipways. These new ways will make a total of ten shipbuilding berths at the plant, and will be augmented by a floating drydock and a number of shop extensions. The drydock, to be completed early in the coming year, will be of 20,000-ton capacity, and will be used for repair work on vessels of large type. Ten all-steel ships of from 5,000- to 15,000-ton capacity have now been completed. Seven vessels are in course of construction, four of these finished early in January. The company is now giving employment to about 10,000 men, and expects to increase this number at an early date. The Aberthaw Construction Company, Boston, Mass., are handling the construction work.

The Carolina Shipbuilding Corporation, Wilmington, N. C., of which Lorenzo Dilks is president, is making substantial progress in the construction of all-steel freighters for the Government. The first vessel was launched early in November. The freighter is of 9,600-ton capacity, 419 feet over all, with 85-foot beam. Each boat is expected to be ready for delivery to the Government in 201 working days from the time of laying the keel. A total of twelve of these freighters will be constructed at the shipyard on the Cape Fear River.

Following its recent purchase of property at Camden, N. J., the Delaware Shipbuilding & Repair Company, 308 Chestnut street, Philadelphia, Pa., is understood to be planning for the construction of a new shipbuilding and repair plant. The site includes about 12 acres of river front property at Erie and Birch streets, and carries an assessment of about $90,000.

The MacDonald Engineering Company, Chicago, Ill., has acquired property at Aransas Pass, Tex., for the construction of a new shipbuilding plant to specialize in the construction of concrete barges. It is proposed to inaugurate work on the plant at an early date; this will include shipways, machine shops, mixing plant and other structures. The company is understood to have a contract for the construction of a number of barges, each about 270 feet long, with capacity of about 3,500 tons.

The H. E. Crook Company, Baltimore, Md., is completing the erection of several additions to its plant, including joiner shop, woodworking plant and other structures, and will install machinery for increased operations. The plant is specializing in the production of schooner barges for the Emergency Fleet Corporation. Three such vessels, each of 2,500-ton capacity, are now being completed. M. M. Davis & Sons, Solomon's Island, Md., will install the mechanical equipment on tugs being constructed for the Emergency Fleet Corporation at the Crook Company yards. This will include engines, boilers and auxiliary power plant equipment. The works now employ about 300 men.

During the past year the Submarine Boat Company, Newark, N. J., has erected a total of over thirty new buildings at its Port Newark plant, with aggregate investment of about $700,000 for this feature alone. The different structures include two steel fitting buildings costing $110,000; brick and steel forge shop, $25,000; steel boiler house, $10,000; steel engine house, $19,000; lunch room for employees, $45,000; pump house, $5,000; nine mess houses, $27,000, and seven compressor houses, $14,000, as well as a large number of smaller structures. The company has launched 17 of the 150 vessels which it will build for the Emergency Fleet Corporation; 28 more are now under way. The company intend to make the plant a permanent shipyard for the construction of merchant and other vessels. About 15,000 men are now employed. This number, it is said, will be increased.

The Norfolk-Hampton Roads Dry Dock & Ship Repair Corporation, Norfolk, Va., has been organized, with a capital of $7,000,000, to construct and operate a local shipbuilding and repair plant. J. B. Morgan is president, O. B. Woodridge, secretary and treasurer. A site of about 250 acres has been acquired. The different structures to be erected will include machine shops for construction and repair work, foundry, pattern

shop, general construction buildings and other miscellaneous structures, including two drydocks, with capacities of 10,000 tons and 15,000 tons, respectively. It is said that the plant will give employment to about 5,000 men for initial operations.

The Maryland Shipbuilding Company, Soller's Point, Md., has commenced the construction of new shop buildings. This plant, which is now in full operation with four shipways, is specializing in the construction of wooden vessels of the Ferris type, each of about 3,500 tons capacity. Other types of vessels are now on the ways. Three will be completed at an early date. The plant covers an area of about 50 acres with water-front and is now giving employment to nearly 800 men.

The William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., has recently filed plans for the construction of a number of additions to its plant at Beach and Ball streets. The new structures include a one-story brick machine shop, about 85 by 220 feet, to cost $65,000; a two-story forge and blacksmith shop, to cost about $35,000; two-story engine house, about 300 by 400 feet, to cost $100,000, and small one-story shop extension, to cost $5,000.

Early in January the Foundation Company, 233 Broadway, New York, will shut down its shipbuilding plant at Kearny, N. J., which has been constructing a number of wooden vessels for the Government. Following the launching of the tenth vessel at the yard, November 16, the works were partially closed down. The yard is the first of the wooden shipbuilding plants to complete its contract with the Emergency Fleet Corporation. For the past few weeks about 400 men have been employed, fitting out the last two vessels with power and mechanical equipment. The machinery and equipment of the plant are now being disposed of to other shipbuilding interests. Former employees of the plant are now engaged at the works of the Submarine Boat Company and the Federal Shipbuilding Company, both in this vicinity.

The Fraser-Brace Shipyards, Ltd., Montreal, Can., has been incorporated by Darley B. Smith, Frank M. Jordan and others of Montreal.

J. P. Donohue, manager of the Standard Shipbuilding Company, Dominion building, Vancouver, B. C., is preparing plans for a shipyard at Port Henry, B. C.

E. C. Ryan, Ballinger, Tex., has purchased 146 acres of land at Harbor Island, and plans to build wharves, piers, slips and warehouses for handling freight.

The Detroit & Windsor Ferry Company, Amherstburg, Ontario, Can., is planning to build a concrete dock.

Drawings have been prepared for the floating drydock, shops and repair plant, involving an expenditure of $10,000,000, at Jeffries Point, Boston, Mass., for the Emergency Fleet Corporation, which is also planning to build a 5,000-ton drydock at Plymouth, N. H., to cost $900,000, and also a drydock at Portland, Me.

The Navy Department, Washington, D. C., is planning to spend $5,000,000 during the coming year for additions to the shipbuilding plant at the League Island navy yard, Philadelphia, Pa.

PLACE GOVERNMENT CONTRACTS AGGREGATING $1,700,000

Private Contracts Now Have a "Look In" on Busy Yards

The United States Navy Department has let a contract for additions and repairs at the Charleston, Mass., navy yard to cost $900,000.

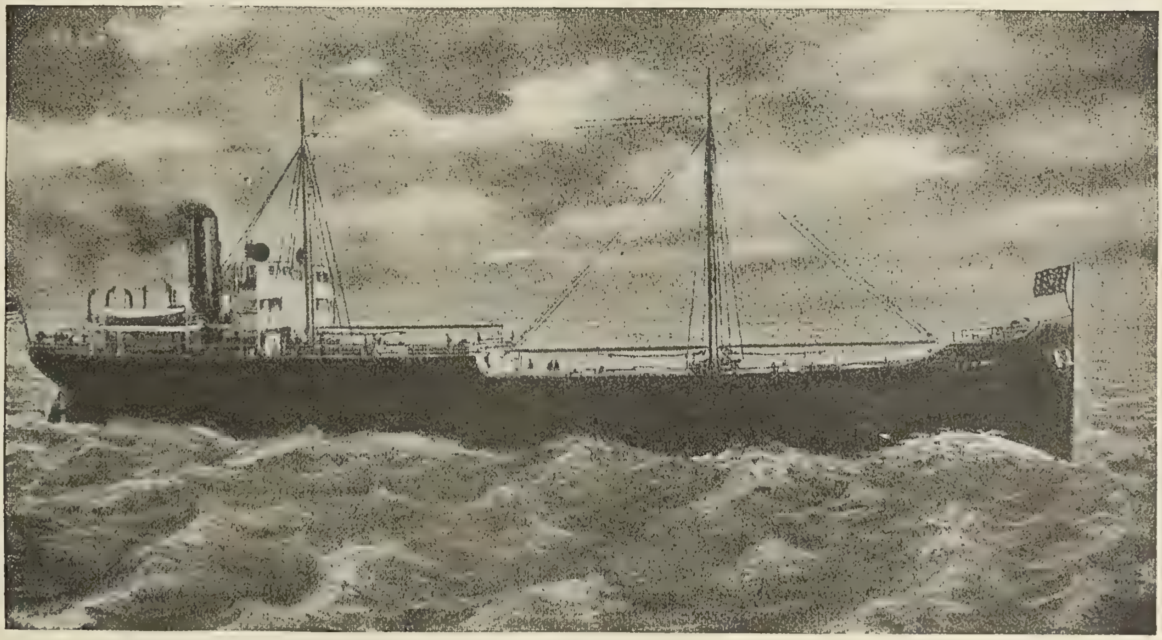
The Rhode Island Dry Dock & Marine Engineering Company, Providence, R. I., has received a contract from the United States Shipping Board to build a drydock in Providence harbor, to cost about $400,000.

The United States Coast and Geodetic Survey, Washington, D. C., will shortly order the construction of two vessels for use on the Pacific Coast, at a cost about $400,000.

The Fore River Shipbuilding Corporation, Quincy, Mass., will build two 33,000-ton superdreadnoughts for the United States Navy Department; the Newport News Shipbuilding & Dry Dock Company has one already well advanced in construction and will build another. The building of these ships was authorized by Congress in 1916, but their construction has been delayed on account of the war.

The Terry Shipbuilding Company, 70 East Forty-fifth street, New York, is building twenty steel barges for the United States Shipping Board Emergency Fleet Corporation.

The Calais Shipbuilding Company, Calais, Me., is building two 2,500-ton wooden seagoing barges.



The city of St. Louis, Mo., J. A. Hooke, City Hall, engineer, is planning to build a 1,000-foot dock to cost about $350,000.

The American Concrete Pipe & Shipbuilding Company, Tacoma, Wash., is building a 120-ton reinforced concrete fishing schooner, two 100-foot concrete tugs and two concrete scows.

The Johnson Shipyards, Inc., Mariners Harbor, N. Y., has received a contract from the United States Shipping Board Emergency Fleet Corporation to build six 2,500-ton wooden barges and four wooden cargo vessels.

Ira S. Bushey & Son, Brooklyn, N. Y., have received a contract from the Standard Oil Company, 26 Broadway, New York, to build twenty-two wooden coal barges and twelve oil barges.

The National Shipbuilding & Dry Dock Company, Savannah, Ga., has recently received a contract from the United States Shipping Board Emergency Fleet Corporation to build several additional steamers.

It is reported that the Foundation Company, Woolworth building, New York, is considering the conversion of its wooden shipbuilding plant in Tacoma, Wash., into a steel shipbuilding plant with eight ways.

The Todd Shipbuilding Corporation is building a 10,000-ton drydock at the shipyard of Harry Cossey, foot of Henry street, Tottenville, S. I., N. Y.

The Navy Department, Washington, D. C., announces that contracts are yet to be placed for twenty-nine ships, the construction of which has already been authorized. They include two battleships, twelve destroyers, ten submarines, two destroyer tenders, a repair ship, a transport and a submarine tender.

The Todd Shipyards Corporation, 15 Whitehall street, New York, has received a contract from the Navy Department, Washington, D. C., for the construction of six self-propelled steel barges, about 160 by 25 by 11 feet. The boats will be built at the Tebo Basin Works, foot of Twenty-third street, Brooklyn, and the boilers will be constructed at the plant of the Quintard Iron Works Company, 742 East Twelfth street.

L. A. Gardner, Stockton, Me., will build two four-masted wooden schooners

Regular Service to Japan

A regular service has been established between Seattle and Japanese and Indian ports by the Yamashita Kisen Kaisha, one of the four large steamship companies of Japan. Five steamers have been assigned to the run between the Puget Sound port and the Orient by the Japanese Company. The Yamashita Steamship Company was established in July, 1911, and is at present operating forty vessels, with a combined tonnage of 134,733 deadweight tons. Prior to the establishment of the service between Seattle and the Orient the company maintained a regular service between Japan, India and Port Said, Straits Settlements, China and the Philippine Islands. Later this service was extended to London and New York.

Prices on German Ship Materials During the War

Consular information has just been received showing prices on metals prevailing in Germany during the war.

Ship plates and angles closed in December, 1916, with a quotation of 400 crowns f. o. b. mill. (The Danish crown equals 26.8 cents at normal exchange; at present its exchange value is about 30.1 cents.) In January the price was increased 75 crowns, and remained at that figure until March, when it rose 25 to 35 crowns. In October the price was increased 100 crowns, and the year closed with quotations of 600 to 625 crowns—an increase of about 225 crowns in 1917. The increase in 1916 had been 238 crowns.

The price of bar iron increased in 1916 from 132 crowns f. o. b. mill, to 225 crowns in the middle of September. After that time no iron was exported from Germany through the remainder of 1916 and far into 1917, and no quotations were made until June, 1917, when the price was 450 crowns for large shipments, or nearly double the price prevailing in September of the previous year. In February, 1917, the basic price of 375 crowns had been, indeed, quoted on an inquiry, but it was expressly stated that no sales could be made. From 450 crowns in June the price rose to 500 crowns in September, 1917.

Great Lakes Vessels Brought to Montreal

Two Great Lake steamers, the Manola and the Van Hise, are being cut in two in Buffalo preparatory to being brought to the European seaboard. Both vessels will proceed to Montreal this week, where they will be rolled over on their sides so as to get through the canals. The work is proceeding under the supervision of John H. Smith, Great Lakes superintendent for the Federal Shipping Board.

IMPORTANT NOTICE TO SUBSCRIBERS

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MARINE ENGINEERING **6 EAST 39th STREET, NEW YORK**

British Construction of Standard and Fabricated Ships

The following list shows the time taken in the construction of the various A, B and E types of ships recently completed in the United Kingdom:

Yards.	Type.	Laying Keel to Launch. Weeks.	Keel Laid to Completion. Weeks.
Belfast	B	34	35
Sunderland	A	29	37
West Hartlepool	E	31	40
Stockton	B	33	46
Sunderland	A	36	46
Do.	B	39	56
Dundee	B	47	56

These three types of standard ships are very similar. Their chief measurements are: A and B types, length, 400 feet; breadth, 52 feet; depth, 31 feet; draft, 25 feet 1 inch; indicated horsepower, 2,850; speed, 11½ knots; tonnage, 5,150 gross, and deadweight, 8,200 for the A and 8,100 for the B type. The E type measurements are: Length, 376 feet; breadth, 51 feet 5 inches; depth, 29 feet; draft, 23 feet 9 inches; indicated horsepower, 2,850; speed, 11⅞ knots; tonnage, 4,400 gross, 7,000 deadweight.

The first of the national fabricated ships, which was launched on August 8 from the Wallsend yard of Messrs. Swan, Hunter & Wigham Richardson, Ltd., was completed on September 28, just thirty-one weeks from laying of keel to completion—a very fine record. It is the pattern vessel, from which many others are being built on the fabrication system, with the aid of bridge-building firms. The vessel is 411 feet 6 inches long, 55 feet 5½ inches broad, 38 feet 1½ inches deep, and has a deadweight carrying capacity of 10,500 tons on a draft of 28 feet 3 inches. Bridge builders being unable to deal with curved surfaces, it is built on a "straight-line" form. There is not a single bent frame in the ship, and all the plating, with the exception of some at the fore and aft ends, is straight.

Another vessel, 6,500 tons gross, of almost the same model, but still a new type, designed by Sir W. G. Armstrong, Whitworth & Company, Ltd., has just been launched from that firm's Low Walker yard. It is the first of a series the firm is building, constructed on the Isherwood system

First "Over the Top" in Shipbuilding

With the launching of the United States steamship *Acrema*, on Saturday afternoon, November 16, the full quota of ships for the Government has been rounded out by the Passaic River shipyard of the Foundation Company. This yard was also the first on the Atlantic and Gulf coasts to launch a wooden hull for the Emergency Fleet Corporation. This ship, the *Coyote*, has already demonstrated in service the excellence and stanchness of the Ferris type of construction. She not only survived a hurricane which drove her on the Bermuda coral reefs, and left her pounding there for twenty-four hours, but she returned to New York under her own steam. Examination in drydock showed that no appreciable damage had been done.

In recognition of the speed and the high standard of workmanship maintained at the Passaic River yard, the United States Shipping Board awarded to this yard the first prize pennant won by any shipyard east of the Rockies. Because of these achievements a special feature was made of the last launching.

Progress in Concrete Ship Construction

On November 21 the *Atlantis* was launched at the Emergency Fleet Corporation's yard operated by the Liberty Shipbuilding Company, Brunswick, Ga. She is a 3,000-ton ship, and the first of a series being built for the Government by the Liberty Shipbuilding Company, whose principal yard is at Wilmington, N. C. A 7,500-ton ship and two 3,500-ton ships are also in course of construction. During the second week in November a concrete lighter was launched by the Aberthaw Construction Company, near Providence, R. I.

On November 12 twelve bids were received for the construction of 500-ton navy coal lighters of concrete construction. It is also reported that a large number of barges, lighters and tugs of concrete are involved in the complete programme of the embarkation service, for which bids will be asked about December 1.

The latest reports from England indicate about 200 concrete vessels are in course of construction, and that the concrete shipyards, equipment and construction, now represent close to $19,000,000 (£4,000,000). Report has been received that a concrete ship of 6,000 tons, built in Spain, has made a successful trial trip.

The final test work has been completed in the "shooting" of concrete on the reinforcing in the construction of a barge. Government experts, and other experts, expressed themselves as entirely convinced of the great success and future of this method of construction after months of investigation and trial.

TRADE PUBLICATIONS

The Lane Timber Planer for dressing ship timbers is described in a catalogue issued by the Lane Manufacturing Company, Montpelier, Vt. This timber planer has its table at an advanced height, and its powerful traveling bed is claimed to make it especially suitable for dressing ship timbers. It planes 27 inches by 16 inches and the cylinder raises and lowers by power.

"Toledo" Refrigeration" is described and illustrated in a circular issued by the Refrigeration Engineering Company, Toledo, Ohio. "Your boats won't be held up for refrigeration machinery if you order from us. Our entire plant has been devoted to the manufacture of 1- and 2-ton marine refrigeration sets, and we can guarantee delivery dates. The Toledo unit construction conserves space and saves time and labor in installing. U. S. Shipping Board and prominent shipbuilders are using Toledo. Ask us for details."

"Hydraulic Tools for Shipbuilding" is the title of a catalogue just published by the Watson-Stillman Company, 30 Church street, New York. This catalogue lists benders, shears, forging presses, forcing presses, punches, jacks, accumulators, pumps, etc. It contains some interesting data about hydraulic machinery in general and ours in particular. "In our experience of seventy years building hydraulic equipment, we have eliminated mistakes and have evolved a line of machinery to meet every need where hydraulic pressure is a possibility. If your conditions are unusual, write to us, and our engineers will adapt a standard design to suit or design new to meet your specifications."

Cutting Compounds, Cutting Oils, Drawing Compounds, Soluble Oils and Quenching Oils are the subject of a booklet issued by the Moore Oil Company, Cincinnati, Ohio. "Thirty years' experience in making lubricants fits us admirably for offering this pamphlet on the subject of cutting compounds, drawing compounds, lard cutting oil, quenching and tempering oils; believing in our own mind they are the best that can be made. It is our aim and desire to always offer the best. Our products before being offered to the public are put to the severest test; and long experience in manufacturing teaches us that to maintain a good reputation we must be thorough and have a perfect knowledge of the conditions under which the goods are to be used."

The Lincoln Arc Welder for Speedy Production is described in Arc Welding Bulletin No. 104-0, published by the Lincoln Electric Company, Cleveland, Ohio. "The answer to the urgent call for speedy production is found in the Lincoln arc welder. The complicated corners that formerly meant slow hand riveting and expensive flanging are now welded by this labor-saving tool in a fraction of the former time. The troublesome calking work that used to bulk so large on the timesheets is unnecessary when the seam is welded up solid with the plates. The tedious 'marking out' on special jobs for the drill press operator is eliminated—there are no rivet holes to drill. Not only does the Lincoln arc welder reduce costs by 50 percent or more but it gives you results 35 percent stronger than single riveting and gets them in less time. Investigate the Lincoln arc welder now. Write for our new bulletin on Arc Welding No. 104-0."

The Electric Arc Cutting & Welding Company, 222 Halsey street, Newark, N. J., describes its apparatus in a circular just published. "Cutting and welding apparatus offered for sale previous to the advent of alternating-current machines employed direct current at the arc. The machines manufactured by this company are designed for use with alternating current, and consist of a special transformer with no moving parts. It will last indefinitely, and do all that D-C machines accomplish and a great deal more. Three types are furnished—cutting, welding, and cutting and welding. The temperature and the amount of heat at the arc can be varied to suit the proper melting points of nearly all metals. The ideal condition for electric arc welding is the absolute control of heat conditions, and this is accomplished with our alternating-current machine, automatically and unchangeably, for any given setting through the use of an easily moved shunt in the magnetic circuit. This enables the operator to take care of conditions requiring various amounts of heat at varying temperatures. The efficiency of this type of electric arc machine is higher than that secured from any other type of electric cutting and welding machines. The loss in power wasted is minimum. The alternating-current machine will deposit metal more cheaply than other types of electric or gaseous welders. Long arc cannot be drawn, which prevents metal spattering and being burned."

Sensitized Papers are the subject of Catalogue H, just published by the New York Blue Print Paper Company, 102 Reade street, New York. "Our papers are the result of many years' experience and experiment in the production of sensitized papers. Compare our papers with others for strength and results, and also note how well they keep their printing qualities."

The Traveling Revolving "Hammerhead Crane," made by the McMyler Interstate Company, Bedford, Ohio, is described in Bulletin No. 40, which the company has just issued. "This crane may be so located as to serve two shipways, as is shown in the cut. The crane occupies very little ground area, the portal at the base providing sufficient clearance so that standard railroad cars may be run through the cranes without interference."

"The Advantages of a Hollow Bolt with the Durability of Ulster Special" are set forth in a circular issued by Joseph T. Ryerson & Son, Chicago, Ill. "Made from the original solid finished bar of identical Ulster Special that is standard for staybolts on majority of leading railroads—no change in process of its manufacture. Self-inspecting—hole perfectly round and true. Guaranteed not to split in threading or driving, which increases output and reduces shop cost. Will pass all railroad and other standard staybolt iron specifications. Furnished in lengths and sizes used; saves time and cost of cutting; eliminates crop ends and facilitates handling. Once tried the results will justify its continued use. Further information, price, delivery, etc., will be furnished on request."

Cleveland Wall Radial Drills are described by the Cleveland Punch & Shear Works Company, Cleveland, Ohio, in a catalogue just published. "The Cleveland wall radial drill is a drilling, reaming and countersinking machine adapted to steel fabricating shop use, and is especially valuable to structural iron workers, bridge builders, ship builders and boiler makers, it being designed to meet the requirements of modern structural fabrication. It has capacity to drill 1½-inch hole in cast iron or soft steel, has a wide range and can be operated easily and rapidly. The horizontal arm can be swung readily by hand, and is made in lengths from 6 feet to 20 feet, as required. The carriage is mounted on trolleys having roller bearings. The spindle is provided with a vertical travel of 8 inches or 12 inches as specified. For reaming and countersinking the drill is built with lever feed only and with hand wheel or automatic feeds with quick return for drilling. The lever feed is always included with the hand wheel feed, and the automatic feed includes both lever and hand wheel feeds. The No. 3 machines are equipped with power-raising and lowering device. The No. 1 and No. 3 machines can be furnished with either direct-connected motor drive or belt drive with countershaft, as desired."

The Star Improved Amsler Planimeter is described by the Star Brass Manufacturing Company, 104 East Dedham street, Boston, Mass., in a leaflet recently issued. "This instrument is one in which extreme care should be used in its manufacture and adjustment. All our instruments are completely manufactured by ourselves in our own works, and are thoroughly tested and corrected before shipment to customer. The planimeter is used to measure the area of any plain surface, whatever the outline may be. Persons who do not understand mathematics are easily able to use it, and with a little practice in following the lines of the surface are able to arrive at accurate results much more quickly and accurately than a skillful mathematician employing ordinary arithmetical calculations. As now made, the figures on roller wheel and vernier are black on a permanent white background, which makes them very clear and legible. The planimeter, in general terms, consists of two metallic arms or bars hinged together at one end. One arm carries a needle-point at its free end and acts as a pivot for the instrument. The other arm carries a tracer point with which to trace the outline of any figure or diagram to be measured. Near the hinge is a roller-wheel on which the instrument moves, carrying a disc graduated to record the area traced about by the point. The instrument shown above is known as the No. 1 style, and represents the planimeter in its simplest form, as designed to measure areas in square inches and decimals of a square inch; it has but one wheel, the figures on which represent units, the intermediate graduation tenths, and the vernier gives the hundredths. One complete revolution of the roller-wheel represents an area of ten square inches measured, and is its normal limit of measurement, but larger areas may be measured by adding ten units to the reading for each complete revolution of the roller-wheel."

The "Red Devil" Rivet Cutter is described by the Rice Manufacturing Company, Fletcher Savings & Trust building, Indianapolis, Ind., in a 32-page illustrated booklet just published. "The 'Red Devil' rivet cutter is a tool which has been successfully developed over a period of years by practical steel car men co-operating with a manufacturer of wide experience in this field. While the principle is simple—that of a plunger driven in a long barrel by compressed air, striking a chisel head—the amazingly hard blows which it strikes are due to the 'Red Devil' method of construction. These exclusive features allow every ounce of air to do full duty. The 'Red Devil' is successful because of the tremendous power which it puts into every blow. These terrific blows will cut 1¼-inch rivets—cold—in an average of ten seconds. One-inch rivets are cut out in from three to five blows. The operation of the 'Red Devil' is simplicity itself. Only three men are necessary to operate the tool. The operator takes hold of the left side handle with his left hand, and rocks the valve handle with his right. Another man holds the right-side handle, while the third holds the chisel on the rivet. Turning the valve handle up opens the air port, which instantly permits the full force of the air to act on the plunger—driving it down the barrel and striking the chisel head. The valve handle is then thrown down to exhaust, and the plunger returns to the head of the tool ready for the next blow. A very little experience will enable the operator to strike light or heavy blows at will. When the rivet is nearly off a light blow can be struck."

Moore's Launching Grease is described in a circular published by the Moore Oil Company, Cincinnati, Ohio. The circular states that this grease is made from finest fats, thoroughly saponified, in order to give proper melting point. It is not affected by heat or cold, is of the right consistency and can be easily applied. It is said to be greasier and to go farther than tallows, stearines or soaps. "Our grease does away with the use of linseed, flaxseed or oil for starting; the ways will remain smoother, because the friction is reduced to the least possible minimum."

"Economical Handling of Coal and Ashes" is the title of Book No. 353, just published by the Link Belt Company, Chicago, Ill. This is a profusely illustrated book of 52 pages, from which we quote as follows: "The modern power plant contains much equipment which is the result of real engineering genius, but it is only recently that the boiler room has begun to receive the attention which it deserves. The development of the electric generator, the steam turbine and the various accessories, has proved a greater attraction to inventive genius than the more prosaic problems of fuel saving and labor saving in the boiler room. As a matter of fact, however, these boiler room savings probably offer greater possibilities than further savings in the generator room."

Small Tools are described and illustrated in Cleveland Hand Book No. 6, just published by the Cleveland Punch & Shear Works Company, Cleveland, Ohio. "By standardizing the sizes of tools as described in detail in the Cleveland system on pages 4 to 7, we are able to fill your orders promptly from stock and at a cost much less than for special tools. Even if you are satisfied with your present arrangement you should become acquainted with this system. Every punching machine should be adapted to use standard tools, both from the standpoint of economy and service. This can readily be done at small cost in the majority of cases by enlarging the bore of the present coupling nut or purchasing a new coupling nut and by shortening or lengthening the punch stem, if need be. We also carry in stock punches and dies for screw punches and portable hand punches, and also the Pratt and Whitney and Richards systems shown on pages 10 and 11. We have had years of experience in manufacturing the tools shown in this handbook, and are constantly experimenting with various steels and processes so as to always give our customers the best."

Cargo Hoists.—Perhaps no work on shipboard requires a better quality of rope than that used in hoisting the cargo from the holds. The constant bending of the rope around the small radius pulleys in the blocks, while the rope is under heavy strain, has a tendency to break the fibers unless the rope has been specially made for use under these conditions. The constant use of the rope in this way generates heat, which, unless it escapes, tends to cause the fiber to deteriorate. Plymouth Manila Best Fall, made by the Plymouth Cordage Company, North Plymouth, Mass., is a rope made to overcome these conditions. It is described in a recent issue of *Plymouth Products*, which is published by the Plymouth Cordage Company, and a copy of which will be sent to our readers upon request.

Forging Presses are described in Bulletin F, issued by the United Engineering & Foundry Company, Pittsburgh, Pa. "Practically every large forge plant in the United States is now equipped with 'United' high-speed steam hydraulic forging presses. We have a number of 1,000- and 1,500-ton presses for prompt delivery."

"Small Tools" is the title of Catalogue 40, just published by the Greenfield Tap & Die Corporation, Greenfield, Mass. This is a very complete and profusely illustrated catalogue of 288 pages. It lists the company's line of taps, dies, screw plates and reamers. The other tools which the company makes, such as pipe tools, machine tools and gages, are taken care of in separate catalogues, a copy of any one of which will be sent to our readers upon request.

The Milliken Bros. Manufacturing Company, Inc., Woolworth building, New York, has just published an illustrated book entitled "Space and Speed in Steel Buildings," giving a description of the "Standardized Truss Unit System" of building construction, designed and manufactured by the company. This system of erection is said to be suitable for all classes of industrial and manufacturing buildings, making use of a simple, common structural steel unit, both for columns and trusses. No plans are necessary, and the buildings are either permanent or portable. The system makes possible low transportation and erection costs. The book shows a number of interesting halftones, illustrating different buildings of this type constructed for the United States Government. Copies may be obtained free from the company by those interested.

Marine Copper Work is the subject of circulars published by E. B. Badger & Sons Company, 63 to 75 Pitts street, Boston, Mass. This company has had seventeen years' experience in designing and manufacturing all kinds of marine copper work, such as copper pipe bending, seamless copper air chambers, copper expansion joints, both high pressure and low pressure, and special copper work of all kinds.

Fireproof Ventilating Flooring is the subject of Catalogue IA10, issued by the Irving Iron Works Company, Long Island City, N. Y. "A metallic flooring with 80 percent lighting and ventilation. Think of that! All the strength and rigidity of solid metal floor plates, with 80 percent opening for light and air. Think of the comfort, the higher efficiency of the men below. And it's just as good for the man on top—comfortable, non-slipping, safe, easy to walk on. Where do you need these advantages in your construction?"

Jeffrey Belt Conveyors are described in a catalogue issued by the Jeffrey Manufacturing Company, Columbus, Ohio. "This new catalogue can rightfully be termed a complete textbook upon the belt conveyor. Although compiled essentially for the purpose of promoting the advantages of using the Jeffrey belt conveyor, the purchaser's requirements for information upon those elements in the application of the belt conveyor which means for satisfactory service, have been thoroughly covered in every detail. The best in belt conveyor practice has been collected and printed in this catalogue, the scope of which may be gathered from the subjects, presented in a style both interesting and instructive."

The Multiwhirl Cooler, designed for the cooling of lubricating oil for main turbine bearings, to insure a uniform low temperature and to permit the continued use of a given quantity of oil, is described in a circular published by the Griscom-Russell Company, 2124 West Street building, New York. "The cooling water is in the tubes. The oil passes through the shell, and is brought into intimate contact with the cooling surface by means of the helical baffle. This baffle directs the flow of the oil without appreciably retarding its passage, with a resultant low pressure loss. An outside packed head eliminates all internal tube joints and prevents any possibility of water leaking into the oil. The high rate of heat transfer permits of a very compact unit."

The Terry Turbine is the subject of Bulletin 242, published by the Terry Steam Turbine Company, Hartford, Conn. "The Terry Turbine occupies a pre-eminent position in its field. Ffteen years ago it was a pioneer—and it still maintains its leadership. For auxiliary drive in the two most exacting fields—the United States navy and the merchant marine—it is the accepted standard of efficiency. In every type of plant, large and small, ashore and afloat power, the Terry is being extensively used for all classes of service. Ever since it was first put on the market the aim has been toward perfection in design and construction rather than minimum first cost. High operating efficiency, long life and low upkeep cost have been considered of more value than low price. The unchallenged position of the Terry to-day is conclusive evidence of the wisdom of this policy."

Dixon's Boiler Graphite is the subject of Bulletin 75-T, published by the Joseph Dixon Crucible Company, Jersey City, N. J. "Dixon's Pioneer Boiler Graphite increases steaming capacity, reduces fuel consumption by making it possible to remove old scale. The action of Dixon's Pioneer Boiler Graphite is purely mechanical. It is unaffected by acid in the water or heat generated in the boiler. The fine flakes of graphite simply work their way through the minute fissures in old scale and gradually penetrate between the scale and the metal. The scale thus loosened may be easily removed at less cost of time and labor. Do not confuse Dixon's with ordinary boiler graphite. Write for booklet No. 75-T, 'Graphite for the Boiler.' It tells how and why Dixon's Pioneer Boiler Graphite will save you money in boiler room maintenance."

Marine Lighting and Signaling Apparatus is described in an illustrated catalogue just issued by the Benjamin Electric Manufacturing Company, Chicago, Ill. "The name 'Benjamin' on marine lighting and signaling apparatus insures an elasticity of service never before possible. For the Benjamin line is thoroughly interchangeable. The Benjamin Junction box, for instance, is tapped to accommodate any Benjamin marine receptacle, connecting block, switch, etc. Changes in the character of service required from any outlet can be made instantly by simply substituting the necessary parts. And Benjamin plugs will make contact in any Benjamin screwbase receptacle. Benjamin apparatus has the unqualified endorsement of the Board of Underwriters and of well-informed marine engineers."

Albany Grease is described by Adam Cook's Sons, Inc., 708 Washington street, New York, in a circular recently issued. "Albany Grease has given a lubricating service of great efficiency and economy on marine engines and other marine mechanical equipment, not only on board ship but in shipbuilding plants, drydocks, and repair yards. It is considered the most universally used lubricant in the marine field. Albany Grease has been used by marine engineers for the past half century with very highly satisfactory results. It can be used successfully on the bearings of all marine equipment. Absolute dependence can be placed on Albany Grease at all times. If you are not using Albany Grease now send for samples. Why not do it—now?"

Radio Sets are described by the Kilbourne & Clark Manufacturing Company, Seattle, Wash., in a bulletin recently published. "When your ships go into drydock for repairs that might have been avoided by prompt communication, who pays the bill? When your ships log useless miles, who pays the bill? When your vessels arrive in port needing repairs for which you are unprepared, who pays for the time lost? When your ships lose the chance to pick up salvage worth hundreds of thousands, who is the real loser? When your ships lay-to and wait for days for a tow, who pays the bill? Isn't it you—the owner—that suffers these losses? With a small initial outlay for a Kilbourne & Clark radio set all these losses would be avoided. It costs scarcely nothing to operate a 'K-C' set. You buy the apparatus outright. The first cost is the last. After that each set starts to make money for the shipowner."

"Aberthaw Construction Service" is the title of a book published by the Aberthaw Construction Company, 27 School street, Boston, Mass. "Whatever your requirements for shipyard building or water-front development, whether the work is to begin now or later, we are ready. An experience covering some of the largest war-time projects, a large permanent organization built up during twenty-five years of active practice, an equipment to meet any requirement—all these are at your service. They make possible the completion of your work with expedition and economy and to your absolute satisfaction. How we organize and manage construction work is clearly explained in our book 'Aberthaw Construction Service.' You should read it before entering upon your new work."

Intercommunication and Signal Equipment for Ships is the subject of Treatise No. 1, published by Department A-2 of the Industrial Division of the Klaxon Company, 33 West Forty-second street, New York. "The war is over, but the hazards of the sea have not passed with it. The dangers incidental to water transportation are fundamental and will continue as threatening as ever before, augmented, for some time to come, by the presence of floating mines, etc. Supplementing the need for protection of lives and property there will now arise a strong demand for the utmost economy in the operation of ships. In connection with such problems of increased protection and economy we wish to call your attention to the Klaxon intercommunication and signal systems. These systems are fully described in our Treatise No. 1, which we will be glad to forward you."

Armco Iron Welding Rods meet United States Government needs, according to a circular published by the Page Steel & Wire Company, 30 Church street, New York. "The Emergency Fleet Corporation specifications demand that welding wire shall contain not over .18 percent of carbon, .55 percent phosphorus, .5 percent sulphur, and .08 percent silicon, and that the wire be of uniform homogeneous structure, free from segregation, oxides, pipes, seams, etc., as proven by micro-photographs. Armco iron welding wire has been tested by the Emergency Fleet Corporation for use in its work and far more than complies with the above specifications. Comparison of chemical composition with these specifications shows that even if Armco iron welding rods had fifteen times as much carbon, nine times as much phosphorus, eighteen times as much manganese, eighteen times as much sulphur, and twelve times as much silicon, as they actually do contain, they would still pass the specifications with a liberal margin. Armco iron welding rods are the Page Steel & Wire Company's answer to demands for the all-American product—provided by American resources and American ingenuity—to replace the imported. Page ideals demand square and unequivocal support of the United States Government, now and always. National service and 100 percent Americanism have therefore led us to give over as much and as freely of our plants as the Government desires—and the indulgence which we must ask of our customers temporarily will be well repaid by the progressive improvement and bettered service which we will offer when normal conditions are restored."

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AMERICA

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Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS
29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS
29 West 39th Street, New York City.

UNITED STATES NAVAL INSTITUTE
Naval Academy, Annapolis, Md.

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GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND
39 Elmbank Crescent, Glasgow.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORPORATED
The Minories, Tower Hill, London.

HELP AND SITUATION AND FOR SALE

No advertisement accepted unless cash accompanies the order.

Advertisements will be inserted under this heading at the rate of 4 cents per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent per word. But no advertisement will be inserted for less than 75 cents. Replies can be sent to our care if desired, and they will be forwarded without additional charge.

Ship Draftsman with selling experience desires sales agency for marine supplies and specialties. Address *Box* 70, care of MARINE ENGINEERING.

Wanted—Marine Engineers, Engine and Electrical Draftsmen, Superintendents for Fitting-Out and Machine Shops. Permanent positions for right men in shipyard near New York City. Address *Box* 97, care of MARINE ENGINEERING.

Wanted—Chief Hull, also Chief Engine Draftsman, familiar with designing, calculating, etc. Permanent position. Write or wire *Box 9-B*, care of MARINE ENGINEERING.

For Sale.—1,000 to 1,200 pieces Iron Boiler Tubing, 60 inches long and 2⅞ inches inside diameter. Will be sold at a bargain. Address *Box* 1184, City Hall Station, New York.

Draftsman—Hull Work. Technical graduate in naval architecture; six years' drafting, inspecting and estimating experience, desires position in shipyard as leading draftsman or estimator. Apply *Hull Draftsman*, care of MARINE ENGINEERING.

First-Class Marine Draftsman and Checker, at present in charge of joiner and carpenter work and inspector of fabricated woodwork, desires position in like capacity or as production engineer or Government inspector. Am a young man of broad experience, graduate of several American and foreign technical schools, 12 years' experience in steel and woodworking, 3 years as efficiency expert. What can you offer me? Address *Marine Draftsman*, care of MARINE ENGINEERING.

Naval Architect and Superintending Engineer of steel and wood yard desires change. Shipbuilding education; practical experience all branches; licensed marine engineer; no dependents. Prefers unusual experience and large chances to salaried position. Address *Box* 594, care of MARINE ENGINEERING.

Production Engineer—Exceptional analytical and executive experience in rate fixing, planning dispatching of men and materials, progress control predetermined and actual costs as applied to a shipyard. Address *Production*, care of MARINE ENGINEERING.

Executive Engineer, experienced in entire charge of hull and machinery, plant layouts and equipment, superintendence and erection. Good references; go anywhere. Responsible position only. Address *Box X*, care of MARINE ENGINEERING.

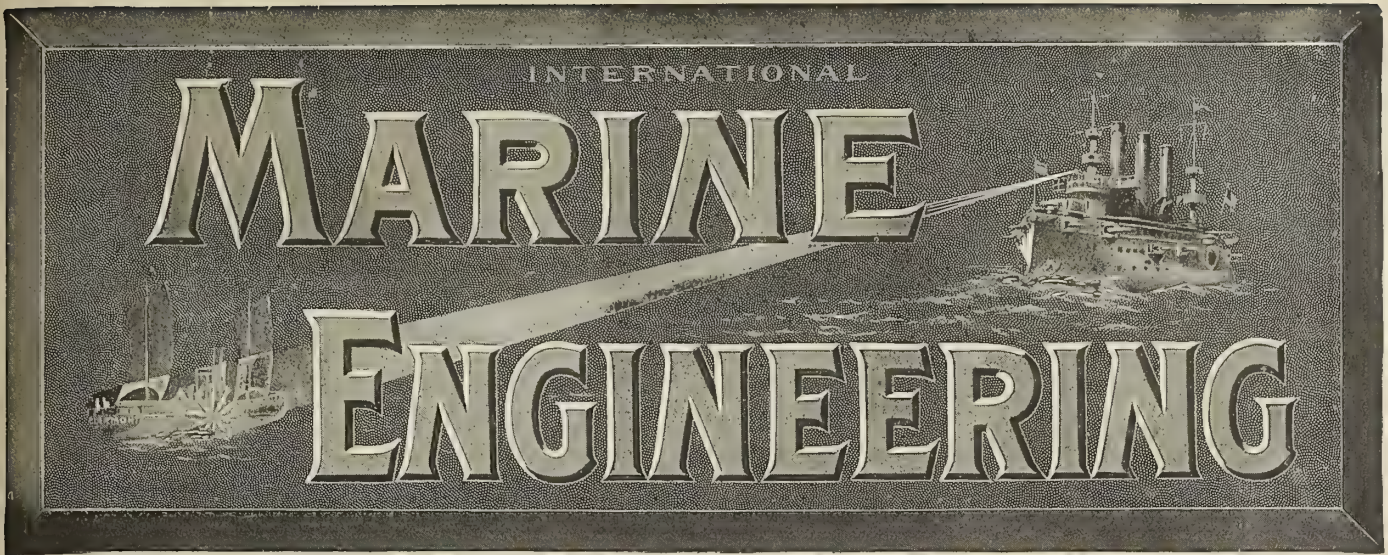
For Sale—Tug W. H. Williams. Iron hull, 90′ x 19′ x 10′; boiler, 10′ 6″ x 12′ 6″; engine, 15 x 28 x 22; bunker capacity, 25 tons. Equipped with condenser, steam steering gear, two steam capstans; electric lights throughout. Entirely rebuilt in 1917 and in first-class condition. Address *Tug*, care of MARINE ENGINEERING.

Marine Superintendent-Foreman desires position. Can give good reasons for desiring change and reference. Now in the West Indies; was before chief engineer; 16 years' experience, working in shipbuilding and machine works. Speaking the French, English, Spanish and Holland languages. Have first citizen papers. Address *Box* 605, care of MARINE ENGINEERING.

For Sale—Full set of working shop drawings of 24 inches by 36 inches, four-cylinder, two-cycle, single-acting fuel-oil engine. About 80 sheets complete for building engine in four months; 1,450 horsepower; suitable and specially designed for Shipping Board vessels; mechanical atomization, marine Marshall reversible valve gear; 60 percent cut-off each for oil and compressed air starting without dead centers; no loose levers, cams or springs; complete control by marine handling levers; write for drawing. Address *Box B* 6, care of MARINE ENGINEERING.

Graduate Naval Architect seeks position as naval architect and secretary of small shipyard, or sales engineer for marine manufacturer. American; age 29; in perfect health. Industrious, resourceful, loyal, tactful. Eight years designer, estimator, executive. Successful business and sales record. Now employed, but desires broader field of service. Address *Box* 507, care of MARINE ENGINEERING.

A Renewable Extra Heavy Bronze Globe and Angle Valve is described in a circular issued by the Star Brass Manufacturing Company, 104 East Dedham street, Boston, Mass. "Some of our special features are enumerated below: All castings of our special bronze mixture, made from metal patterns on pneumatic molding machines. All parts made with special tools, insuring absolute uniformity. Body of a special rugged design; steam is not retarded in its flow owing to body's form—it is so designed that metal is distributed where most needed for severe use. Seat and disc are both renewable and extra heavy; the bevel or taper of both are at a sharp angle, with a very light bearing, insuring less liability of foreign matter lodging on seat when valve is closed, also less chance of wire drawing and cutting. Seat rings are of a patented form with special taper seat where screwed in body. This design insures a perfect joint and absence of liability to distortion from lack of care in installation or unequal expansion in use. The bonnet is novel in design, having many unique features. First, it is absolutely self-draining, thereby eliminating all liability to freeze when used in cold positions; has extra large and deep packing space, gland and nut; long thread in body, insuring strength and tightness. Stems, or spindles, are extra heavy, made with large Acme quick-opening threads. Valves can be repacked under pressure when wide open, as top of disc seats against bottom of bonnet, making steam-tight joint. Hand wheel is fastened to stem with hexagon nut, and can readily be removed and replaced. For extreme high temperatures and pressures, or where the water is such as to cause a scaling or corrosive action, we furnish, when specially ordered, seats and discs of our special nickel mixture."



Main Office: NEW YORK 6 East 39th Street SUBSCRIPTION PRICE: Domestic, $2.00; Foreign, $3.00 LONDON OFFICE: 8 Bouverie St. E. C.

This table shows the Monthly Coal Saving, in Dollars and Cents per 100 feet of pipe *by using* "85% Magnesia" Pipe-Coverings

Size of Pipe Inches	5 lbs. Steam Pressure	10 lbs. Steam Pressure	50 lbs. Steam Pressure	100 lbs. Steam Pressure	150 lbs. Steam Pressure	200 lbs. Steam Pressure	200 lbs. Steam Pressure 100° Sup-Heat
½	$1.44	$1.58	$2.20	$3.28	$3.66	$4.11	$6.80
¾	1.72	1.89	2.87	3.70	4.26	4.89	8.03
1	2.11	2.30	3 56	4.80	5.35	6.04	10.00
1¼	2.52	2.74	4.22	5.52	6.50	7.25	12.20
1½	2.86	3.10	4.73	6.14	7.29	8.17	13.70
2	3.53	3.74	5.86	7.63	8.93	10.11	16.80
2½	4.25	4.39	6.95	9.07	10.55	11.90	19.90
3	5.00	5.33	8.30	10.90	12.60	14.30	23.82
3½	....	6.22	9.60	12.40	14.40	16.32	27.23
4	....	7.06	10.60	14.05	16.40	18.40	30.85
4½	....	7.69	11.80	15.35	17.92	20.25	34.00
5	....	8.64	13.16	17.20	20.00	22.72	38.00
6	....	10.15	15.60	20.38	23.82	26.88	44.90
7	....	....	18.38	23.68	27.60	30.80	52.00
8	....	....	20.40	26.60	31.20	34.90	58.55
9	....	....	22.70	29.00	34.52	38.61	64.80
10	....	....	25.00	32.70	38.40	43.08	72.40
Boilers and flat surfaces per 100 sq. ft. 1¼ in. thick	5.26	5.67	8.80	11.50	13.48	15.12	25.44

FACTS are enlightening things. For the man who doesn't see how it is that "85% Magnesia" pipe and boiler coverings save their cost many times over, *here are the figures.*

They are conservatively based on the most exhaustive series of tests ever made. These tests extended over more than a year. They were conducted by the Mellon Institute of Industrial Research, a scientific institution of the highest standing, which certifies their absolute correctness.

What Will "85% Magnesia" Save You?

We ask your special attention to the fact that these savings are *per hundred lineal feet of pipe per month.* To find the actual saving for your own steam plant you must *multiply* this monthly saving by the number of hundreds of feet of steam pipe you have. To find the total saving for a full year, you must again multiply this figure by *twelve.*

Then you will know the exact coal-saving efficiency of "85% Magnesia."

We ask you to make these figures personal. They apply to *you* equally with every other coal user in the country. They cannot be controverted. The need for fuel economy is *yours.* Equally, the means for saving by the use of "85% Magnesia" coverings are at *your* disposal.

Ask Yourself These Important Questions:

Am I saving all the coal I can?

Are my pipes and boilers properly covered with the most efficient heat-saving insulation?

Is it "85% Magnesia"?

The cost of thorough protection by "85% Magnesia," against heat losses, will repay itself, not in years but in *months.* It will continue to save indefinitely, not only in the actual money cost of coal but also by greatly increased *efficiency* in the operation of your steam plant, whether it be used for heating or power.

The National Coal Saver

The value of "85% Magnesia" as a conserver of heat and saver of fuel is demonstrated by the fact that for over thirty years it has been the official standard of the U. S. Navy. During this same period it has been the choice of the leading power and heating engineers of the country and of the leading railroads and steamship lines. It is endorsed and approved by the U. S. Fuel Administration and the U. S. Shipping Board.

The World-War of Industries

The coming economic world-struggle will be purely one of industries. The best equipped factories, with the lowest cost of production and the greatest economy of operation, will be the most successful. The basis of all industry is *coal.* To save coal is one of the mightiest steps towards industrial supremacy.

Copies of this table will be sent free on request. The members of the Magnesia Association will gladly furnish further information if desired, on this vital subject of heat insulation. If you are an engineer or architect, ask also for the Specification for the proper application of "85% Magnesia," compiled and indorsed by the Mellon Institute of Industrial Research and issued by the

MAGNESIA ASSOCIATION *of* AMERICA

721 Bulletin Building, Philadelphia, Pa.

EXECUTIVE COMMITTEE, Wm. A. Macan, *Chairman.*
George D. Crabbs, The Philip Carey Co., Cincinnati, Ohio
Alvin M. Ehret, Ehret Magnesia Mfg. Co., Valley Forge, Pa.
J. R. Swift, The Franklin Mfg. Co., Franklin, Pa.
R. V. Mattison, Jr., Keasbey & Mattison Co., Ambler, Pa.

First Warrior River Cargo En Route to New Orleans

That utilization of the Warrior River, as planned by the Federal Railroad Administration, has actually been brought about is indicated by the recent landing of the first consignment of coal from the Alabama fields at Mobile. Here it was transferred to one of the self-propelling barges and sent on to New Orleans. The 2,250 tons brought down in five barges were towed by the steamer *Volcano.*

Guns Removed from Merchant Marine

The return of merchant vessels to peace conditions is evidenced by the removal of guns and gun platforms from ships as they arrive at their home ports from overseas, and the transfer of the gun crews back to naval duties, now going forward under the direction of the Shipping Board.

Bethlehem Shipbuilding Corporation Signs Agreement With Labor Unions

Seventy-five thousand members are affected by the contract of the Bethlehem Shipbuilding Corporation, a Schwab company, which recognizes the labor unions. The details of the contract were modeled somewhat on the plan worked out in settlement of the Bridgeport cases. Wages are not touched in the articles of the agreement, since the recent award of the Shipping Board's wage adjustment commission continues in effect.

Battleship Massachusetts "Out of the Running"

The battleship *Massachusetts,* which was built at Cramps in Philadelphia, and began actual service in 1896, it is understood will shortly be placed out of commission. It is the second oldest vessel of her class in the navy. Whether the vessel will be dismantled or scrapped, or assigned to some passive roll, has not yet been announced.

Largest Wood Craft Launched

With the launching of the 4,000-ton wood steamship Blakeley recently the Puget Sound Bridge and Dredging Company put the largest wood craft so far built in Seattle, as well as their first vessel for the United States Shipping Board, into the waters of Elliott Bay.

National Motor Boat Show to Be Omitted This Year

In view of the conditions now confronting the motor boat industry, the executive committee of the National Association of Engine and Boat Manufacturers has decided to suspend the holding of the National Motor Boat Show for this season.

The association is endeavoring to obtain either an elimination or revision of the taxes that are at present incorporated in the proposed new revenue act. Present difficult transportation, including both freight and express shipment, is receiving consideration by the association, and the facts will be brought to the attention of the Railroad Administration in the near future.

First Concrete Ship Launched at Gloucester, England

Although commonly regarded as an inland city, Gloucester, England, possesses a dock system with a water area of about 12½ acres, and is in communication with the Bristol Channel by means of the Gloucester and Berkeley ship canal. On the left bank of this waterway is constructed the concrete shipbuilding yard of the Gloucester Ferro-Concrete Shipbuilding Company, working on the Mouchel-Hennobique system of construction. Of the four vessels first laid down, one was launched on November 23 without a hitch, the *Creterock,* a sea-going barge of 1,000 tons deadweight capacity, built for the Controller-General of Merchant Shipbuilding, in accordance with the structural designs of Messrs. L. G. Mouchel & Partners, of Westminster. Since the ship canal is not of sufficient width for launching vessels end on, the yard has been arranged for side launching, a somewhat unusual method in England.

Largest Steel Cargo Vessel Launched

What is said to be the largest steel cargo craft built in the United States since the inception of the emergency shipping programme, was recently launched at the Sun Shipbuilding plant at Chester, Pa. The craft is a steel steamship of 13,600 tons, originally ordered for the account of the Luckenbach Steamship Company of New York, but later commandeered by the Government, and when completed will be delivered to the Emergency Fleet Corporation.

Japan's Shipbuilding Programme for 1919

One of the local Japanese shipping offices has just received a statement of Japan's shipbuilding programme for 1919, or, to be exact, from November, 1918, to October, 1919:

Builders	No. of Ships	Deadw't Tonnage
Kawasaki Dock Yard	37	333,000
Osaka Iron Works, Osaka	9	83,000
Osaka Innoshima Branch	8	74,000
Mitsuibishi Shipbuilding Co., Nagasaki	10	74,300
Mitsuibishi Shipbuilding Co., Kobe Branch	6	33,500
Uraga Dock Co.	12	91,260
Asano Dock Yard	10	88,000
Harima Dock Co.	8	67,500
Yokohama Dock & Engineering Co.	9	58,200
Mitsui & Co., Shipbuilding Department	7	45,000
Uchida Shipbuilding Co.	5	34,000
Ishikawajima Dock Yard	6	30,000
Nitta Shipbuilding Co.	7	25,600
Osaka Shipbuilding Co.	8	24,000
Asahi Dock Yard	4	22,000
Others	35	105,125
Total	181	1,189,285

JAPANESE CONTRACTS FOR AMERICAN SHIPS

Builders	No. of Ships	Deadw't Tonnage
Asahi Dock Yard	1	5,500
Fujimagata	1	6,300
Harima Dock Co.	2	15,500
Ishikawajima Dock Yard	2	10,000
Kawasaki Dock Yard	5	45,000
Nitta Shipbuilding Co.	1	5,500
Yokohama Dock & Engineering Co.	3	18,900
Asano Dock Yard	2	25,200
Uraga Dock Co.	3	19,950
Mitsui & Co., Shipbuilding Department	2	18,200
Mitsuibishi Shipbuilding Co., Nagasaki	2	16,800
Uchida Shipbuilding Co.	2	17,000
Osaka Shipbuilding Co.	4	42,000
Total	30	245,850

Society of Automotive Engineers' Winter Meeting

On February 4, 5 and 6 the Society of Automotive Engineers will meet to discuss reconstruction problems. Of special interest to marine engineers will be the address by Dr. Joseph E. Pogue, of the Bureau of Oil Conservation of the United States Fuel Administration Bureau, on the interpretation of the engine fuel problem. A paper on better truck performance, by Major Arthur B. Browne, is also scheduled. Papers on tractors and tanks will probably for the first time bring out a number of new engineering features incorporated in these new types of war apparatus, which may be applicable to other phases of commercial practice. The standards committee of the society is also reported to be including interesting details in its report. All meetings of the society will be held at Madison Square Garden, New York City.

Proposed Subsidies for Argentine Shipbuilders

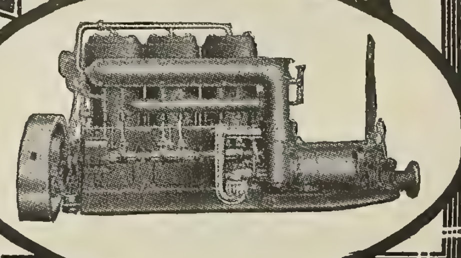
President Irigoyen has submitted a new project of law relative to the encouragement of shipbuilding in Argentina. This industry has not heretofore received any special aid from the State, and the proposed legislation is intended to afford such help. The executive power considers that the most practical method of developing the national shipbuilding industry is by facilitating the establishment of shipyards through the granting of liberal concessions of property sites for periods sufficient to insure their development; and, further, by the award of bounties for the new shipping constructed. The president deems the project justified by the imperative necessity of augmenting the Argentine mercantile marine. The maximum tonnage in view is one of 250,000 three years after the promulgation of the law, 400,000 after four years, and 500,000 after five years.

The bill provides that concessions for the installation of shipbuilding yards shall be granted for terms not exceeding forty years. Firms participating in the benefits accorded by this law within five years from the date of its promulgation, will be permitted to occupy, gratuitously, until December 31, 1930, the necessary fiscal lands.

The following table shows the scale of bounties for ship construction, payable in 5 percent bonds of the Credito Argentino Interno:

Class of Vessel.	Period Within Which to Be Built and Placed in Service.* Years.	Bounty Per Registered Ton. Paper Pesos.†
Self-propelled, over 700 tons, steel hull	1½	100
Do.	3	60
Do.	4	40
Do.	5	20
Self-propelled, over 200 tons, wood or concrete hull	1½	50
Do.	3	35
Do.	4	20
Do.	5	10
Sailing vessel or lighter without self-propulsion, over 200 tons, steel, wood, or concrete	1½	30
Do.	3	20
Do.	4	10
Do.	5	5

* After promulgation of the law. † Value about 96.5 cents.



Passaic Yard First to Fill Government Quota

With the launching of the *Acrema* at the Passaic River shipyard, the Foundation Company brought to a close the most successful wooden shipbuilding plant on the Atlantic coast.

In the spring of 1917 the Foundation Company received authorization to build a shipyard in the vicinity of New York City. Despite the unprecedently congested conditions at that time the yard was completed as scheduled, and the first wooden ship launched on the Atlantic or Gulf Coast was delivered to the Emergency Fleet Corporation by this yard.

This ship, the *Coyote*, has already demonstrated the sturdiness of her construction by her survival of the hurricane which drove her on the coral reefs of Bermuda, and left her pounding there for twenty-four hours. Four of the *Coyote's* sister ships built in the Passaic yard are now in service. Although it is regrettable, of course, that the work of such an effective shipyard has been brought to a close, the closing, however, will have comparatively little effect upon the shipbuilding activities of the Foundation Company, which operates two other yards on the Atlantic coast, one on the Gulf, one on the Great Lakes, and three on the Pacific Coast. At these yards the company has under contract 128 ships of both wood and steel.

In addition to the seven 3,500-ton wooden steamers of the *Coyote* type which have already been turned over to the Shipping Board from the Passaic Yards, the company has made the following deliveries: Eight 250-ton wooden deck barges to the United States navy, five 2,800-ton wooden steamers to the British Imperial Munitions Board, and twenty-eight 3,000-ton five-masted steam auxiliary schooners, fully equipped ready for service, to the French Government.

The Savannah, Ga., yards will soon be in a position to deliver the first of thirty-eight 150-foot steel mine sweepers which are being built for the French Government.

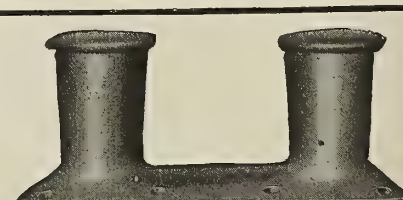
TRADE PUBLICATIONS

Parkesburg Charcoal Iron Boiler Tubes are described by the Parkesburg Iron Company, Parkesburg, Pa., in a circular recently issued. Parkesburg Charcoal Iron Boiler Tubes are made from the same grade of knobbled charcoal iron which we have been producing continuously during the past fifty years. Good charcoal iron tubes will outlast steel tubes, due to their resistance to corrosion and crystallization, and tubes from Parkesburg charcoal iron are in service in marine boiles after thirty years' continuous use."

Camerin Pumps for Marine Service are described in illustrated Bulletin No. 7205, just published by the A. S. Cameron Steam Pump Works, 11 Broadway, New York. "A record of years of satisfactory service is behind the Cameron marine pump. It has been severely tested in many installations, and has proved highly successful. The principal reasons for this remarkable success are its simple design, rugged construction, high-grade materials and exact workmanship. The Cameron vertical marine pump has the fewest working parts, yet it embodies every feature that is necessary to meet the most exacting requirements. The steam mechanism has only four pieces, which are unusually strong. The valve gear is of the piston type, suitable for the highest pressures and superheat. The absence of the external valve gear permits unusually compact construction. Cameron marine pumps are making good on the hardest jobs for others, and they can do it for you. Full information on request."

The Multiwhirl Cooler is described in Bulletin 901, just issued by the Griscom-Russell Company, 2124 West Street building, New York. "In the past few years the cooling of lubricating oils for use in turbine bearings, reduction gears and similar heavy duty work and oil for heat treatment quenching systems has received considerable attention by engineers. It has become imperative to devise a means of cooling this oil so that the same quantity of oil can be used over and over again, and so that the oil can be maintained at the proper temperature to secure the most efficient operation. Numerous devices were placed on the market, but none handled the situation fully in its various phases. The engineering and designing staffs of the Griscom-Russell Company devoted years of study and experiment to this problem and finally perfected Multiwhirl Cooler. Following this period of development a series of tests was run to determine the proper ratings, pressure losses, etc., for oils of various characteristics. The results secured more than met all expectations. The rate of heat transfer is greatly in excess of that which has been secured by any previous type of commercial oil cooler, and at the same time the oil pressure drop is considerably lower."





"How to Buy a Crane Wisely" is set forth in Bulletin 401-A, issued by the Pawling & Harnischfeger Company, Milwaukee, Wis. "The purchase of a crane entails much more than a mere examination of specifications and securing the lowest possible price. Its consideration begins when the building or structural plans are being drawn. Just as production of machinery in other fields has been standardized, so the component parts of cranes have been standardized in the P. & H. shops. While it is not feasible to build cranes and lay them 'on the shelf,' the basic design is uniform, and manufacture of parts follows this design; adaptation to installation is but a matter of dimension. It is obvious that standardized production of any commodity results in a better commodity and a much lower cost per item of production. To repeat, the purchaser of a crane begins with consideration of building plans. After a building is up and ready for occupancy the owner frequently discovered the structure is not adapted to a standard crane, but that the crane builder must adapt a crane to the structure, which means that the standardized production system of the crane manufacturer must be bent to the construction of a special type of crane, with a resulting higher production cost and purchase price. Such a condition is caused by neglecting the matter of overhead clearance in the building plans, *i. e.*, distance from top of runway rail to roof and from center of rail to adjoining wall. A poor runway is also a prolific source of trouble. The runway should be strong enough to avoid undue deflection between columns, and it should be stiff enough sidewise to take up the impact due to sudden starting and stopping of the trolley. If the span is not absolutely uniform, there is grave danger of heavy wear on track wheels, resulting in repair bills and high power consumption."

"Stop Wasting Man Power" is the title of a circular published by the McCabe Manufacturing Company, Lawrence, Mass. "With man power both scarce and execssively high, you can protect your flanging output and costs by installing a McCabe pneumatic flanging machine. With but two operators the McCabe will flange your sheets cold up to and including ½ inch in thickness. No lost time waiting for heats—no extra man required—no back-breaking sledging to retard your shop output. The McCabe is a powerful and sturdy machine that will solve your flanging problems. May we tell you in detail 'how' and 'where'?"

Oxweld Injector Type Welding and Cutting Blowpipes are described and illustrated in a bulletin issued by the Oxweld Acetylene Company, Newark, N. J. "Oxweld injector type welding and cutting blowpipes are the most efficient and economical, regardless of the source of your acetylene gas supply. Where for portability or other reasons compressed acetylene is used from cylinders, Oxweld injector type blowpipes utilize far more of the contents of the cylinders than will any other type of blowpipe. Oxweld low-pressure acetylene generators possess advantages that are possible only in a generator of the low-pressure type—namely, simple and automatic action, operation at a pressure of less than ½ pound per square inch, and delivery of a constant flow of acetylene to the blowpipes at unvarying pressure."

Laminated Shims for Marine Use are described in a catalogue published by the Laminated Shim Company, 533 Canal street, New York. "Laminated shims are quickly and easily made by merely peeling off layers of brass to required thickness. There is no filing; no assembling of loose leaves; no fiber to wear away. Accurate shims in a jiffy. Think of the time, money and labor saved! Here is one sure method of decreasing costs while increasing efficiency—for a Laminated shim is absolutely accurate; the adjustment perfect; the surface smooth as glass. Speed up with Laminum for bearing adjustments—composed of a number of layers of brass held firmly together by metallic binder."

Valbestine Twisted Valve Steam Pacing is described in a circular issued by the General Asbestos & Rubber Company, Charleston, S. C. "One spool of Valbestine will furnish the finest kind of packing for every size valve in your plant. No other packing made fills a wider range of usefulness or shows bigger savings in time or money. Only carefully selected long-filler asbestos is used in making Valbestine. Each strand before being twisted into the finished size is thoroughly saturated with Garco self-lubricating compound. Valbestine is soft, pliable, flexible. It cannot stick, harden or char. Because Valbestine is thoroughly saturated before being made up, each individual strand can be untwisted and made into a perfect packing for any size valve. It is guaranteed—can be used equally as well on valves operating in steam, hot or cold water, oil or acid. Your jobber will gladly give you prices on Valbestine. If he can't supply you for any reason write us direct. We'll send you a sample free."

"Acetylent Pressure Generation in Your Own Plant." This is the subject of a bulletin published by the Davis-Bournonville Company, ersey City, N. J., from which we quote as follows: "The largest steel mills, foundries, shipyards, locomotive and car shops and sheet metal working plants, making the most extensive use of the oxy-acetylene process in welding and cutting, for manufacturing and for repair work, generate acetylene in their own plants as it is wanted, with Davis acetylene pressure generators—the acme of efficiency, simplicity, economical production. Acetylene at approximately 1 cent per cubic foot, under pressure, automatic operation, piped to any part of the plant, and no gas holders with storage of free gas. Made in three types—stationary, portable and two-pressure generators for combined pipe-line service and compression into portable cylinders. Stationary acetylene pressure generators in five sizes:

No.	Carbide Capacity Lbs.	Water Capacity Gals.	Acetylene Per Hour Cu. Ft.
25	25	25	25
50	50	50	50
100	100	100	100
200	200	200	200
300	300	300	300

Hourly output is in accordance with the rules of the Underwriters' Laboratories of the National Board of Fire Underwriters. Davis generators are installed in batteries for greater requirements; many plants have batteries of from two to twelve of the No. 300 generators. Carbide is estimated to produce from four to five cubic feet of acetylene per pound of carbide, a full charge to operate for the full working period of four to five hours. Davis acetylene pressure generators were designed specially for oxy-acetylene welding and cutting installations, and are manufactured with twenty years of experience in acetylene generation. They were the first automatic-feed pressure generators, the first on the inspected list of the National Board of Fire Underwriters, and have been in constantly increasing successful use. The list of successful users is significant—write for it and for detailed information and engineering service to determine the practicability of operation in your own plant."

The Marine Engines, marine engine parts, heavy gray iron and semi-steel castings made by the Hooven, Owens, Rentschler Company, Hamilton, Ohio, are described in a circular just issued.

Benjamin Marine Lighting and Signaling Apparatus is described in an illustrated catalogue published by the Benjamin Electric Manufacturing Company, Chicago, Ill. "The name 'Benjamin' on marine lighting and signaling apparatus insures an elasticity of service never before possible. For the Benjamin line is thoroughly interchangeable. The Benjamin junction box, for instance, is tapped to accommodate any Benjamin marine receptacle, connecting block, switch, etc. Changes in the character of service required from any outlet can be made instantly by simply substituting the necessary parts. And Benjamin plugs will make contact in any Benjamin screw base receptacle. Benjamin apparatus has the unqualified endorsement of the Board of Underwriters and of well-informed marine engineers."

Marine Steam Turbines are the subject of Bulletin No. 241, just published by the Terry Steam Turbine Company, Hartford, Conn. "American naval vessels—the ships that guarded our crusaders over seas to the Great Adventure; from keel to wireless tip these valiant defenders of the right carry the best there is in the way of equipment. With a world to choose from the navy selects its equipment not only with discrimination but with unerring precision. For a product to become standard in the navy, therefore, is a proof of its worth. So when you enter the market for steam turbines keep this fact in mind: The United States navy uses more than 1,000 Terry turbines. If you would know why write for Terry Bulletin No. 241. It shows why so many navy engineers advise."

The Lysholm Patented Plate Punch Table is described in a catalogue published by the Norbom Engineering Company, Denckla building, Philadelphia, Pa. One of the illustrations shows a Lysholm plate punch table punching 4,000 holes per day in steel plates. "Rapid production in punching holes in boiler plate is made possible on this machine by means of a roller table. Lateral and sidewise movements are under the lever control of the operator. The tables are built with roller bearings to facilitate rapid movement of the work. Plates up to 30 feet by 8 feet from 1/4 inch to 1 1/8 inches in thickness may be handled readily. Various shipyards and plate shops have reported records that average 4,000 holes per nine-hour day. Six thousand seven hundred holes in a nine-hour day is a common occurrence. Full information on request."

The Stratton Air Separator is described and illustrated in Bulletin 1110, published by the Griscom-Russell Company, 2124 West Street building, New York. "Air always contains a certain amount of water vapor, the quantity depending upon the locality, altitude and weather. After air has been compressed and its volume therefore reduced, the original quantity of water in the air becomes a much greater proportion of the air volume. The air becomes saturated above the point at which it can carry all of this water as a vapor, just as a sponge can hold only a certain amount of water without dripping, and the lightest pressure added after this point is reached will cause water to fall from the surface. In the case of air, if compression were not accompanied by a rise in temperature of the air, this water vapor would be condensed, but as it is, the increased temperature of the air, due to compression, serves to maintain the water as a vapor. If this high temperature compressed air were supplied to sand blast machines, pneumatic tools, etc., it would be cooled by its passage through pipe lines and by its contact with the machines, with the result that the water vapor would be deposited as liquid water. In sand blast machines it would cause the sand to pack and prevent it from flowing freely from the blast nozzle, thus impairing the efficiency and necessitating frequent shut-downs for cleaning. Water in the air supplied to pneumatic tools would occupy valuable power space in the cylinders of the tools, decrease their efficiency, and if enough were present would result in damage to the tools themselves. It can be readily seen that it is vitally important to remove the water from compressed air before the air is used. The first step toward attaining this end is to reduce the temperature of the air low enough to insure that practically all of the water has been condensed. This is usually accomplished by proper water cooling of the compressor cylinders, or by the use of after coolers. However, neither of these devices removes the water from the air; they merely condense the vapor and bring the air into a condition, permitting the mechanical removal of the water by a Stratton Air Separator."

The "Giant" Semi-Diesel Fuel Oil Engine is described in a bulletin just published by the Chicago Pneumatic Tool Company, 1044 Fisher building, Chicago, Ill. "Realizing the widespread demand existing for a low-grade fuel oil engine, correct in principle and built to endure the severe usage that such engines must withstand, we have employed our broad experience and unusual facilities in the design and production of the Giant Semi-Diesel fuel oil engine, described in the pages following. The severity of the service and the widely varying degree and quality of fuels employed impose requirements in an engine of this character that must be met with an intelligent knowledge of service conditions only obtainable through broad observation and thorough tests. Intricate mechanism and delicate adjustments have no place in an engine for this work. The Giant semi-Diesel fuel oil engine is the result of several years of painstaking development. Although introduced only about five years ago, there are many thousand horsepower of these engines in successful service."

Power Punches and Shears are described in a catalogue issued by the Beatty Machine & Manufacturing Company, Hammond Ind. One of the illustrations shows the company's No. 7-72-inch throat; capacity, 1¼-inch hole through 1-inch plate. "Arranged for direct-connected motor drive, fitted with floating punch stem and electric solenoid for operating clutch. All shaft bearings are of phosphorous bronze, bushed and fitted with ring oilers."

The "Fourth Edition of "The Starrett Book for Machinists' Apprentices," published by The L. S. Starrett Company, Athol, Mass., has just been issued. The book, now in its thirty-fifth thousand, is a well-illustrated colume of 176 pages, bound in red Athol leather, and designed to answer in an authoritative manner questions as to how to do the every-day work of the average machine shop. The different classes of work are taken up separately, the most common errors pointed out and the correct practice indicated. Much attention is given to the proper use and care of tools, the reading of micrometers and verniers, bench work, lathes and lath tools, grinding, belts, gears, etc. The book is essentially for the apprentice rather than the expert machinist, though the latter will find much of interest and value, and is intended to provide the answers to the many questions usually asked of the foreman or superintendent. Distribution is being made exclusively through the hardware dealers handling the Starrett line of tools, the price being 50 cents per copy. The briefest examination of the volume will convince the ambitious apprentice or machinist of its value in his everyday work.

HELP AND SITUATION AND FOR SALE

☞ *No advertisement accepted unless cash accompanies the order.*

Advertisements will be inserted under this heading at the rate of 4 cents per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent per word. But no advertisement will be inserted for less than 75 cents. Replies can be sent to our care if desired, and they will be forwarded without additional charge.

Sales Engineer, experienced in marine engineering and naval construction open for engagement. Is familiar with domestic and foreign markets. Address *Naval Engineer,* care of Marine Engineering.

Executive Engineer, experienced in entire charge of hull and machinery, plant layouts and equipment, superintendence and erection. Good references; go anywhere. Responsible position only. Address *Box X,* care of Marine Engineering.

Position Wanted by Naval Architect, technical assistant to executive, or designer for consulting naval architect. Technical graduate, twelve years' steel experience. Competent executive, energetic and systematic. Address *Box* 117, care of Marine Engineering.

Is There Such a Place? Marine Engineer, technical, wide experience, wishes to locate with American associations only, where "pep" and "go" are the passwords, simplicity of design and system is the goal, and where old maids and piddlers are absolutely not. Address *American,* care of Marine Engineering.

Young Man, aged 24, with technical education, five years' experience as engine draftsman, estimator and charge man, now employed in Gulf Coast yard as chief draftsman, is open for position with East or West coast yard. Holds first assistant engineers' license. Is married. References. Address *Gulf Coast,* care of Marine Engineering.

Man Experienced as Manager, contractor's superintendent and chief engineer; now with Concrete Ship Section E. F. C., wants to organize some existing shipyard for construction of concrete ships, or establish new yard. Acquainted with all available concrete ship talent, and could enlist strong organization immediately. Address *Organizer,* care of Marine Engineering.

For Sale—Full set of working shop drawings of 24 inches by 36 inches, four-cylinder, two-cycle, single-acting fuel-oil engine. About 80 sheets complete for building engine in four months; 1,450 horsepower; suitable and specially designed for Shipping Board vessels; mechanical atomization, marine Marshall reversible valve gear; 60 percent cut-off each for oil and compressed air starting without dead centers; no loose levers, cams or springs; complete control by marine handling levers; write for drawing. Address *Box B* 6, care of Marine Engineering.

Shop Superintendent, who is a Mechanical Engineer, experienced in boiler shop work, especially Scotch marine boilers. Is well versed in shop management. Will guarantee to take any boiler or machine shop and increase its production 20 percent. First-class reference. Address *Box* 41, care of Marine Engineering.

Mechanical Engineer wants position as production manager or general shop superintendent. Experienced in boiler construction, machinery building and erecting, structural iron fabricating and erecting. Latest methods in shop management. Salary $5,000 to $8,000 per year, depending on scope of work. Age 36. Address *Box* 93, care of Marine Engineering.

For Sale—Tug W. H. Williams. Iron hull, 90' x 19' x 10'; boiler, 10' 6" x 12' 6"; engine, 15 x 28 x 22; bunker capacity, 25 tons. Equipped with condenser, steam steering gear, two steam capstans; electric lights throughout. Entirely rebuilt in 1917 and in first-class condition. Address *Tug,* care of Marine Engineering.

Wanted—A bargain in some freight steamer. Any size from 1,000 to 5,000 tons. What is wanted is a sound, old and slow freight steamer, for very cheaply carrying iron ore a long distance in the ocean. Should be either auxiliary or capable of being made such. Advertiser is in no hurry and will wait until he gets a bargain for cash. Answer with full details as to length, beam, draft, tonnage, age character of boat, price, etc. Address *Freight Steamer,* care of Marine Engineering.

Wanted—Naval Officer, expecting release from service desires position as Marine Superintendent or Superintending Engineer with steamship or tug line. Hold chief engineers' license for unlimited ocean tonnage. During war served ten months as chief engineer of a battleship and eleven months supervising hull and machinery repairs on naval and merchant type vessels. Go anywhere. Industrious, loyal and progressive. Address *Marine Superintendent,* care of Marine Engineering.

Wanted—Cheap for Cash, a small, old-fashioned, coal-fired steam harbor boat, suitable for carrying 6 or 8 passengers and 2 to 3 tons of freight from mainland to island 4 miles in the ocean, where the weather is sometimes rough. Fancy boats not wanted. Only a very cheap, rough, out-of-date boat, which is or can be well housed over for protection against bad weather. Address, giving full particulars, age, size, shape, price, etc., *Harbor Boat,* care of Marine Engineering.

A Practical Iron and Steel Shipbuilder and Marine Engineer, aged 40, is free to accept an appointment as manager of a shipbuilding concern in January, 1919. Ten years' experience as manager of shipbuilding, combined with ship repairing and engineering establishment. Thoroughly conversant with present-day methods of merchant ship and engine construction. Repairs to hull and machinery, classification requirements organization and North Country costs of shipyard labor. Address *"Z. N. 174,"* care of Deacons, Leadenhall Street, London, England.

Mechanical Engineer, with twelve years' experience on marine work, desires change. Employed with Shipping Board since war started, but wishes to return to commercial work. Particularly experienced in the design of reciprocating, steam and Diesel engines and auxiliaries. Graduate of leading university, in both mechanical and electrical engineering. Address *Commercial Work,* care of Marine Engineering.

Graduate Naval Architect seeks position as naval architect and secretary of small shipyard, or sales engineer for marine manufacturer. American; age 29; in perfect health. Industrious, resourceful, loyal, tactful. Eight years designer, estimator, executive. Successful business and sales record. Now employed, but desires broader field of service. Address *Box* 507, care of Marine Engineering.

Ship Repairer, Builder, Naval Architect, Marine Engineer and Estimator, twenty years' experience in steel shipbuilding in all its branches, desires responsible position with established shipbuilding or repairing plant. Up-to-date methods, coupled with economy for quick handling of large repair and conversion jobs. Experience in naval as well as all kinds of mercantile craft. Age 36; would go anywhere. Address *Box* 998, care of Marine Engineering.

"Cutting Costs by the Brown Portable Continuous Motion Handling Machine" is the title of Bulletin No. 2, just published by the Brown Portable Conveying Machinery Company, 10 South La Salle street, Chicago, Ill. "Brown portable handling machines cut handling costs to the minimum—saving from 50 percent to 80 percent of hand methods' cost. The difference (in the money saved) goes into your profits every year. These handling machines do the work (with less men) in from one-third to one-half the time. A 'Brown-Portable'—though using few men—makes every work day twice or three times as long in money value—in work produced. Also, a 'Brown-Portable,' in reducing a force of men to a few men, is an insurance against labor difficulties and labor shortage. They make the laborious work so easy that your best workers stay with you."

The Standard Cutting Torch, manufactured by the General Welding & Equipment Company, 107 Massachusetts avenue, Boston, Mass., is described in a circular just issued. "Many thousands of these cutting torches are in daily use all over the United States and Canada, a greater part being repeat orders from concerns having used these cutters for a number of years. They work in shipyards, arsenals, steel foundries and other important concerns. Their principal features: Our cutters are second to none in efficiency, economy and endurance. They are so constructed that all parts of the cutting torch are easily accessible and exchangeable, and can be repaired in a few minutes by your own man. With carrying a few spare parts, a burnt and even smashed-up cutter can be fixed up like new in less than half an hour. No cutter need come back to our factory to be repaired. You can do it yourselves and avoid the delay of a week or two."

The "High Cost of Riveting" is reduced to a minimum by installing Hanna type riveters, according to a bulletin published by the Vulcan Engineering Sales Company, 1755 Elston avenue, Chicago, Ill. "They are made in 120 styles and sizes. One machine illustrated is a new type of punch and riveter. It has a reach of 18 inches and a gap of 15 inches. Develops 80 tons on the die at 100 pounds air pressure. Punching capacity, 1-inch holes in ⅜-inch material; riveting capacity, 1-inch steam-tight rivets. Absolutely tight rivets are driven with a single blow. Time is saved and hydraulic results are obtained at one-third of the power cost."

"The Wrench Booklet," published by J. H. Williams & Co., 63 Richards street, Brooklyn, N. Y., has just been published. "Pursuant to our policy, inaugurated nearly half a century ago, of standardizing lines of drop-forged wrenches, we have now developed some forty patterns in about 1,000 sizes, with openings from 3/16 to 7⅝ inches for various trade needs. All are reliable, efficient tools, made of the best materials obtainable for the purpose and manufactured by methods developed and perfected through many years' experience. But we realize that design, utility and quality alone are not of consequence if we cannot ship on receipt of specifications. Therefore we have pleasure in announcing we are ready to deliver from stock—ship on the same day that order is received—95 per cent of our catalogue wrenches, each of which is designed for the greatest utility and wear in its par-

The McNab "Logometer" is described in a bulletin published by the McNab Company, Bridgeport, Conn. "The McNab Logometer is an instrument specially designed for, and is highly approved by, the Engineering Section of the Emergency Fleet Corporation for installation in the engine room under Technical Order No. 104.

"The Only Strictly Marine Type Oil Filter Made" is described in Bulletin B No. 26, just issued by the Richardson-Phenix Company, 118 Reservoir avenue, Milwaukee, Wis. "Filtration of used oil from reciprocating engine or turbine-driven ships, makes the ship independent of fresh supplies at foreign ports and reduces the space occupied by the supply of fresh oil it is necessary to carry—two considerations which are extremely important under present shipping conditions. So important are these two items considered by the Emergency Fleet Corporation, that an oil filter is part of the standard engine room equipment of all their ships. Oil does not wear out; it merely gets dirty; remove the impurities, and the lubricating properties of the filtered oil are equal to new oil. Of course, filtering the used oil and using it over and over saves many dollars on oil bills. The No. 70 Peterson Marine Type filter shown was specially designed to meet Emergency Fleet specifications. It is being installed on hundreds of this corporation's ships. It is efficient, sturdily built to meet marine conditions, without any moving parts, to be periodically replaced, and it is easy to clean while in operation."

Lidgerwood Steam Mine Hoists and steam and electric hoists for all purposes, cableways and cableway excavators are the subject of a handsomely illustrated catalogue, No. 19, just issued by the Lidgerwood Manufacturing Company, 96 Liberty street, New York.

The "Maxi Tap" staybolt tap is described in a circular issued by the Greenfield Tap & Die Corporation, Greenfield, Mass. "Two of the features which make the 'Maxi' staybolt tap such a phenomenal producer are the pilot point and the chip breaker. The pilot point acts like a bridge reamer, aligning the holes for the remainder of the operation. The chip breaker prevents the accumulation in the flutes of long, tightly curled chips, which clog and retard the progress of the ordinary tap."

"Leaders in Peace or War" is the
ticular field of activity."
title of a circular published by the Sperry Gyroscope Company, Manhattan Bridge Plaza, Brooklyn, N. Y. "With the advent of peace the Sperry Gyroscope Company announces that it is able to supply gyro-compasses for use on ships of the merchant marine. During the war nearly one thousand Sperry gyro-compasses have been constant aids on the thousands of miles of patrol covered by each vessel of the allied navies under all conditions of weather, and proved of invaluable assistance in navigating hazardous waters and making rendezvous at all times of day and night. The compass being non-magnetic, is not subject to the usual errors and discrepancies of the magnetic compass, and thereby insures a truer course with greater safety and economy of time."

INTERNATIONAL

MARINE ENGINEERING

Main Office: NEW YORK 6 East 39th Street SUBSCRIPTION PRICE: Domestic, $2.00; Foreign, $3.00 LONDON OFFICE: 8 Bouverie St. E. C.

(C) Underwood & Underwood

The Record of "85% Magnesia" in America's War Fleet

The Navy is always reticent as to its achievements, but gradually its part in the great war is becoming known. Little by little we are learning how largely America's ships and American sailors were responsible for the downfall of the submarine and the final surrender of the enemy fleet.

When the full story can be told, it will be found also that "85% Magnesia" has fully maintained its reputation as the national coal saver and defender of steam.

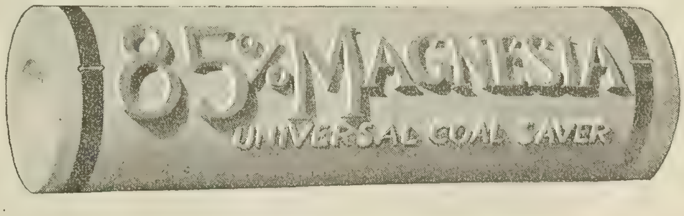
Every one of Uncle Sam's huge battleships, every American transport, and every destroyer has its pipes and boilers protected against heat leakage by an impenetrable armor of "85% Magnesia."

In the arctic weather of stormy Northern waters, amid snow and ice that often covered the decks and sides of the vessels for days at a time, through days of dark Atlantic gales, the fleet never failed in its mission, nor did the "85% Magnesia" covered pipes and boilers fail to deliver a plentiful supply of hot, dry steam to the engines.

The country is justly proud of its Navy. We take both pride and pleasure in the fact that "85% Magnesia" did its share to make the Navy's triumphs possible.

We invite everybody interested in coal saving to write for the Table showing the actual Saving in Dollars and Cents by the use of "85% Magnesia" coverings. This Table, prepared by the Mellon Institute of Industrial Research, is the result of over a year's exhaustive tests, under actual service conditions. To engineers we will also send copy of the Magnesia Association Specification, compiled and endorsed by the above Institute.

MAGNESIA ASSOCIATION *of* AMERICA



**721 Bulletin Bldg.
Philadelphia
Penna.**

Executive Committee, Wm. A. Macan, *Chairman*

George D. Crabbs The Philip Carey Co. . . Cincinnati, Ohio
Alvin M. Ehret Ehret Magnesia Mfg. Co., Valley Forge, Penna.
J. R. Swift . . . . The Franklin Mfg. Co., Franklin, Penna.
R. V. Mattison, Jr., Keasbey & Mattison Co., Ambler, Penna.

BUSINESS NOTES

The Independent Pneumatic Tool Company has opened a branch office and service station at 1103 Citizens' building, Cleveland, Ohio, under the management of Hayden F. White.

J. G. Osgood

J. G. Osgood, lately manager of the pneumatic tool sales for the Chicago Pneumatic Tool Company, and for twelve years a member of their sales organization, became general sales and service manager of the Keller Pneumatic Tool Company on February 1.

Announcement is made of the reorganization of the Talbot Engineering Corporation, to manufacture Talbot boilers, engines, valve fittings, pumps and supplies. The corporation has established an engineering consulting board at its New York office, 66 Broadway. Factories in both the United States and Canada provide facilities for prompt deliveries on complete marine machinery from 100 horsepower up. The Talbot power plant is being adapted to burn coal as well as crude oil of all grades.

Under the firm name of A. A. Gray & Company, Anslie A. Gray, who lately received an honorable discharge from the Ordnance Department of the United States Army, in which he served during the war, has opened offices at 1547 Marquette building, Chicago, Ill. He will direct the efforts of a staff of competent men in assisting manufacturers in solving their problems of production, selling and distribution.

C. I. Henrickson. late of the Dayton Pneumatic Tool Company, has again been retained by the company for special advertising work in connection with the private advertising service which he has organized in Chicago. His offices are located at 609 Fisher building.

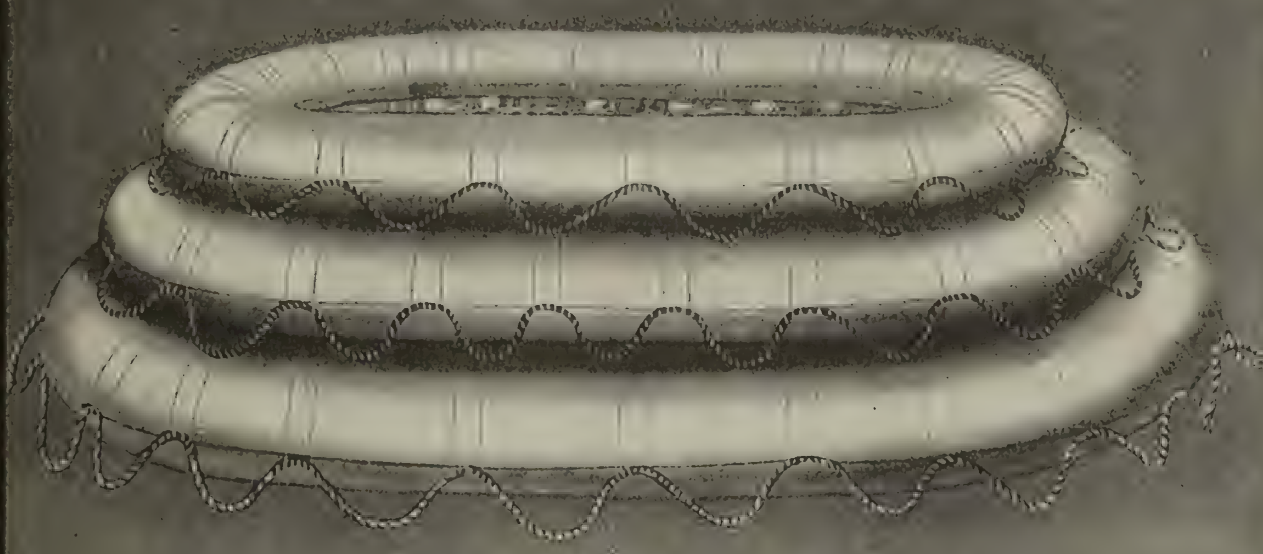
On January 1 the Duntley-Dayton Company took over the entire output of the Dayton Pneumatic Tool Company, Dayton, Ohio, and announced its entry into the pneumatic tool field. W. O. Duntley, former president of the Chicago Pneumatic Tool Company, is president of the new concern. Offices of the company are located in the Westminster building, Chicago; 295 Fifth avenue, New York, and in the Commercial Trust building, Philadelphia.

W. O. Duntley

J. L. Crowley has been appointed special railroad representative of the Rich Tool Company, of Chicago. His headquarters will be located at the company's main office in the Railway Exchange building.

SAFETY AT SEA

We do our bit in the manufacture of Marine Life-saving Appliances that will safeguard the lives of our officers, sailors, gunners and troops on ships going into the war zone



A nest of A. B. C. Life Rafts—Balsa Wood

For a great many years we have specialized in the manufacture of the highest grade of marine lifesaving equipment such as:

- Lundin Decked Lifeboats
- Lundin Motor Lifeboats
- Welin Quadrant Davits
- Norton Sheath Screw Davits
- Standard Metallic Lifeboats with "Steel Keels"
- Compensating Quadrant Cranes
- Metallic Cylinder Life Rafts
- Mills' Releasing Gear
- A. B. C. Life Rafts
- A. B. C. Life Preservers
- A. B. C. Ring Buoys
- Welin Gripe Release
- Welin Non-Toppling Blocks

Our policy is: "The best is none too good"

Catalog on Request

AMERICAN BALSA COMPANY, Inc.

Welin Marine Dept. 50 E. 42nd Street, New York

London House: 5 Lloyds Avenue, London, E. C.

H. W. Ullman has been appointed representative in the St. Louis territory for the Rich Tool Company, of Chicago, with offices at 103 Security building, St. Louis, Mo.

The New Jersey Zinc Company has announced the establishment of its general offices at 160 Front street, New York City.

The John L. Whiting-J. J. Adams Company, Boston, Mass., has received a contract to supply the United States Navy with paint and scrubbing brushes. The order amounts to about $140,000.

The Eastern branch of the Independent Pneumatic Tool Company in New York will be moved from 170 Broadway into larger quarters at 1463 Broadway, at Forty-second street, on March 1.

British Shipping Losses

The *Daily Telegraph*, London, in an article by Archibald S. Hurd, reports that Great Britain lost 9,000,000 tons of shipping during the war. This amount is ten times as much as was lost by either France or Italy, and seventeen times as much as was lost by the United States.

Cost of Repairs on Lake Boats

Repairs on the steamer *M. A. Reeb*, which is being repaired at a Buffalo drydock, will cost from $125,000 to $135,000. The cost of ship repairing on lake steamers is becoming a very important matter to underwriters. For example, the repairs on a Cleveland steamer last summer cost more than the hull valuation. The steamer was valued at $220,000, and the repair bill was $230,000.

New Insignia to Be Carried on Shipping Board Vessels

The Shipping Board has ruled that the letters *S. B.* appear on vessels chartered from that organization. The American steamer *Lake Marion*, with cargo for the Mallory Line, between Mobile and Cuba, is probably one of the first vessels to bear the new insignia.

Developments in the Employment Division of the Atlantic Coast Shipbuilders' Association

Meetings have been held on February 7, at the Adelphia Hotel, Philadelphia, and on February 28, at Chester, Pa., to discuss the various employment problems arising with the necessary labor adjustment and unemployment conditions resulting from the shifting of labor.

At the first meeting it was decided to include only employment managers of shipyards at future meetings. Attention was called to the creation of a committee on information, which was established as a clearing house on information regarding labor supply. C. S. King, as secretary, will act as correspondent, and Paul Grendall as chairman. It was decided to publish the report on labor turnover adopted by the committee at the November meeting.

At the March meeting, Earl Dean Howard, employment manager for Hart, Schaffner & Marx, and chairman of the Industrial Relations Committee of the United States Chamber of Commerce, will give an address. Employment managers of the Atlantic Coast, Gulf of Mexico and Great Lakes districts will be present at this meeting.

Shipping Lectures at New York University

Under the auspices of the Wall Street Division of New York University, William M. Brittain is delivering a series of lectures on Merchant Marine Administration and Operation at 25 Broad street, New York City.

The lectures will cover the following: American merchant marine; Government relation to shipping; physical features of merchant fleet; types of water carriers; rates and rate structure; ship operation; admiralty law and the law of carriers; international and constitutional law affecting shipping; ship and freight brokerage; marine underwriting and taxation of shipping.

San Francisco Eliminates Wharfage Charges

By a decision of the State Board of Harbor Commissioners of California wharfage and dockage charges will be elimination at the port of San Francisco after April 1, 1919.

More Consuls Needed for Our Merchant Marine

Since our merchant marine is rapidly outgrowing our consular service, steps are being taken immediately to provide facilities abroad for handling the millions of tons of shipping which will be afloat under the American flag in peaceful trade when the war is over. A study of this subject has been made in connection with the developing of American merchant marine; the facts are being presented to the nation so that intelligent public opinion may guide Congress when appropriations for the consular service are made.

Drydock Construction at Quebec

Special features in the construction of the drydock now building at Quebec, Canada, merit notice. The concrete retaining walls on each side of the dock are specified to be built from the natural rock surface to elevation +24, and are intended to prevent seepage through the filling. In the prism of the dock the drilling of the rock, which consisted of hard shale, irregularly stratified at an angle of about 45 degrees, was for the most part done by two well drillers, the holes being sunk down to grade and plugged for future blasting. On the west side considerable rock slides necessitated a much larger quantity of concrete for the dock wall, together with the use of rock bolts to prevent the sliding tendency of the wall.

The floor and walls of the dock are of concrete, the mixture being 1-3-5; all exposed faces are finished with a fine 1-2-4 concrete for a thickness of 6 inches. The concrete for the walls and floor was cast in alternate sections of approximately 30 feet, with expansion joints. The steps at the top of the walls are of granite, as also are the altars, the caisson stops of both entrances, and all culvert openings. The floor, 5 feet thick, is finished level from end to end, and is provided with three strips of granite slabs, 18 inches thick, intended to receive the cast iron keel and bilge blocks. The keel blocks, 4 feet 4 inches long and 2 feet 3 inches high, are each built of three pieces of castings. The middle block is wedge-shaped, so that it may be knocked out and the block removed from under a ship when in the way of repair work. The upper part of the top piece of casting is provided with a piece of white oak tenoned into the casting.

AMONG THE STEAMSHIP COMPANIES

Five of the vessels of the Union Line Steamship Company running between San Francisco and Australia are being returned to service. With the acquisition of these vessels pre-war schedules for freight and passenger service will be resumed.

The American Steamship Line is operating the Shipping Board's steamship *Zirkel* between New Orleans and Liverpool.

The United States Steamship Company has sold three Great Lakes steamships, the *Bingham*, *Minneapolis* and *Huron*. Between $1,000,000,000 and $2,000,000,000 are involved in the deal.

The International Shipping Company, a new steamship combine which will develop shipping trade from San Francisco to Japan, is composed of the Frank Waterhouse Company, of San Francisco and Seattle; Iwai & Company, of Kobe; I. Shii, of Kobe; Senda Barnet Company, Ltd., of Calcutta, and Suzuki & Company, of Kobe. The merger will control cargo vessels representing more than 500,000 deadweight tons.

The Harrison direct line from Tacoma to Liverpool has been resumed, according to the announcement of Guthrie & Company, Tacoma.

On February 2, J. H. W. Steele Company, of New Orleans, purchased an office building formerly occupied by the United Fruit Company's passenger and freight offices on Common street, New Orleans. On the same day the *Quistconck*, the first of ten vessels which will be operated out of New Orleans by the new Steele line, was being loaded with with cotton and general cargo for Genoa.

Firemen Needed on Government Ships

The United States Shipping Board needs 1,500 Americans at once to learn firing boilers on the new ships. The men will receive $30 a month for thirty days, and then will be sent on deep-water voyages at $75 a month. Uniform and board are furnished free.

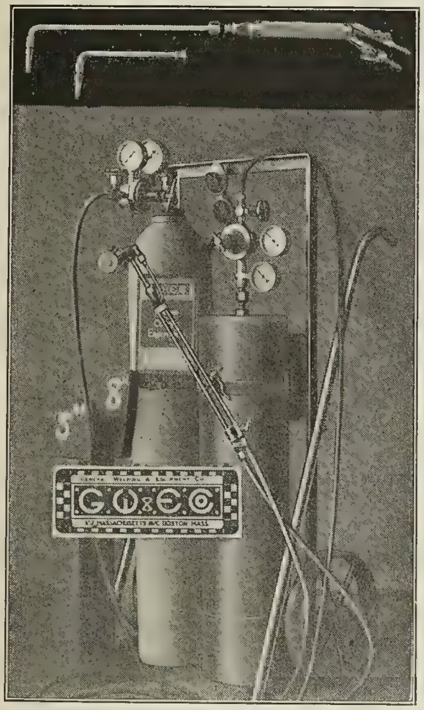
GENERAL WELDING & EQUIPMENT CO.

G. W. & E. Co.

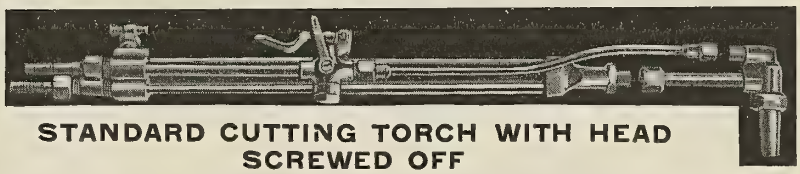
107 MASS. AVE. BOSTON, MASS.

IN USE AT
BETHLEHEM
SHIPBUILDING CORP.
FORE RIVER, SQUANTUM,
PROVIDENCE.
TEXAS STEAMSHIP CO.
CANADIAN VICKERS CO.
WATERTOWN ARSENAL
LORD CONSTRUCTION CO.
GENERAL ELECTRIC CO.
CANADIAN PACIFIC R. R.

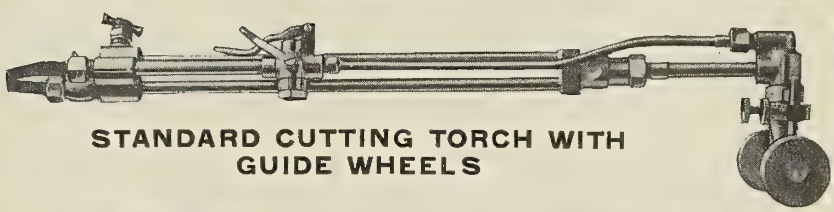
STANDARD WELDING AND CUTTING EQUIPMENT



STANDARD WELDING AND CUTTING EQUIPMENT



STANDARD CUTTING TORCH WITH HEAD SCREWED OFF



STANDARD CUTTING TORCH WITH GUIDE WHEELS

STANDARD WELDING TORCH WITH 3 EXTENSIONS, TO HAVE EITHER A 16-IN. LONG TORCH OR A 22-IN OR A 30-IN. LONG ONE.

DESCRIPTION:

1 **REGULATORS** ARE OF THE DOUBLE DIAPHRAGM SYSTEM, THAT IS TO SAY, THE MOVABLE CENTERPIECE B CARRYING SEAT C IS NOT ONLY TIGHTLY FASTENED TO MAIN DIAPHRAGM A BUT ALSO WITH FITTING H TO REAR DIAPHRAGM G. THUS SEAT C IS FORCIBLY GUIDED AND RESTRICTED TO AN ABSOLUTELY STRAIGHT UP AND DOWN MOVEMENT, KEEPING ALWAYS THE SAME RELATIVE POSITION TO NOZZLE D. THE REAR DIAPHRAGM ACTS AS A FORCIBLE AND FRICTIONLESS GUIDE AND ALSO AS A QUICK ACTING DOUBLE WAY SPRING ENFORCING AN ACCURATE AND SENSITIVE REGULATION.

NO OTHER REGULATOR HAS THESE ESSENTIAL FEATURES.

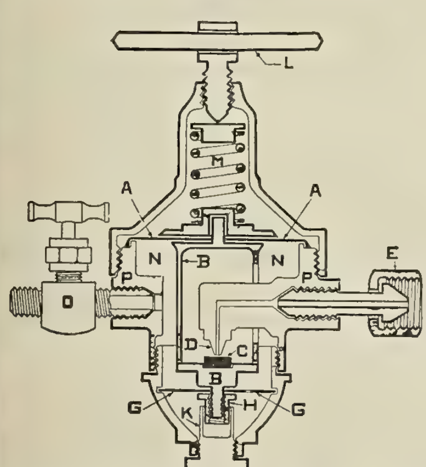
2. **WELDING TORCHES** CONSIST OF A TORCH BASE WITH 2 EXTENSIONS TO HAVE EITHER A 16-IN. LONG TORCH OR A 22-IN. LONG ONE GIVING YOU PRACTICALLY TWO TORCHES IN ONE. A THIRD EXTENSION MAY BE ADDED TO HAVE A 30-IN. LONG TORCH. THUS ONE TORCH WITH ITS 9 TIPS IS SUFFICIENT FOR ALL POSSIBLE REQUIREMENTS.

3 **CUTTING TORCHES** ARE SECOND TO NONE IN EFFICIENCY, ECONOMY AND ENDURANCE. EVERYTHING IS OF THE MOST MODERN OPEN CONSTRUCTION. EACH PART CAN BE REACHED AND INSPECTED WITHOUT DELAY THE PICTURE ON TOP SHOWS A TORCH WITH THE HEAD SEPARATED FROM ITS BASE. BY LOOSENING TWO NUTS THE WHOLE HEAD COMES, SHOWING HOW EASY IT IS TO EXCHANGE EVEN A COMPLETE HEAD.

MANY THOUSANDS ARE IN CONSTANT USE.

4. EVERYTHING IN OUR CONSTRUCTIONS IS EASILY ACCESSIBLE AND EXCHANGEABLE. WITH CARRYING A FEW SPARE PARTS YOU CAN DO YOUR OWN MAINTAINING EVEN IN FAR AWAY COUNTRIES.

GET OUR CATALOGUES.



DOUBLE DIAPHRAGM REGULATOR
PERFECT, FORCIBLE, FRICTIONLESS ALIGNMENT; DIFFERENTIAL SPRING ACTION PRODUCED BY THE DOUBLE DIAPHRAGM (A and G) SYSTEM; QUICK, SENSITIVE AND RELIABLE REGULATION.

Lake Vessels Subject to Heavy Duty

A large number of American ships in winter quarters at Canadian ports for repair, it is reported, will have to pay a duty of 50 percent. This expense with the added cost of repairs at Canadian ports will be a very severe handicap for the lake shipping interests if the ruling stands as it reads at present.

Shipyard Workers to Form a Council

A movement is on foot to organize the workers in the metal trades in the Atlantic coast shipyards. The organization would include workers in the yards from Maine to Mexico. A similar organization has been formed on the Pacific coast.

Technical Training for Ship Firemen

Among the training projects of the various branches of the Government that have grown out of the war is a "college" for merchant marine firemen in Chicago. Holding that the marine fireman's job is more than merely shoveling coal on a fire, the Shipping Board has prepared for intensive, scientific training of its firemen.

One aim in this training is to secure conservation of coal. It is believed that a fireman who knows the heat value of the fuel he is handling, the laws of combustion and the principles of operation of the boilers can save at least a ton of coal a week, as compared with the untrained man.

No More Wooden Ships for the Imperial Munitions Board

With the putting into service, on February 15, of the last of the forty-seven wooden ships constructed under the direction of the Imperial Munitions Board, the Dominion Government will discontinue wooden ship construction for the present.

Record of American-Made Vessels

Of the 78 vessels which are carrying food products to Europe, 72 fly the American flag. Of this number 64, aggregating 5,544,306 deadweight tons, were built by the present Shipping Board, established since August, 1917.

Special Machine for Milling Ship's Planking

A special machine for milling ship's planking, ceiling and other curved and beveled members, has been perfected by William D. Fletcher, naval architect at the yard of L. H. Shattuck, Inc., Portsmouth, N. H.

It consists of an ordinary bed and feed mechanism with a tilting vertical cutter head. It is especially actuated by hand control, so as to taper, bevel and outgage for calking in one operation. Details for milling are taken from the shell expansion plan and plotted upon the template on a reduced scale, showing width, degree of bevel and butt spacing. The template is carried on spools passing over the template table at the side of the machine, and the cutter head is actuated in accordance with pointers following the plotted lines. Data so far in hand, according to L. H. Shattuck, Inc., indicate a saving of 33 percent in man hours for planking.

British Ship Repairing as Well as Shipbuilding Now Under Private Control

Following the announcement of Lord Pirrie, that English shipyards were again open for private contracts, he mentioned that the ship repairing organization must be continued for a short time in order to avoid unnecessary congestion.

Shipowners, however, are now allowed to place repair orders through their own agents. Lord Pirrie urges, however, that English shipyards and repair docks be patronized as much as possible.

Steel Output

It is announced that the United States Steel Corporation is now producing about 100,000 tons a month. In most cases this is going into stock. It is evident from the decrease of more than 1,400,000 tons in unfilled orders over the months of December and January, that 80 to 85 percent of the operations are not the result of large orders. New business, it is reported, is slightly in excess of 30 percent of production.

Reports compiled by the American Iron and Steel Institute show that twenty-nine companies during January produced 3,082,427 tons of steel ingots, the largest output since the record month of October, 1918.

Wooden Cargo Vessels Remain Unchartered on the Pacific Coast

Instructions have been given to the Pacific Steamship Company and the firm of Sudden & Christenson, which were to have managed ten wood vessels in transit from the Pacific to the Atlantic, that these are to be held in Pacific ports pending change of freight rates. About fifty of these vessels have been chartered on the Atlantic coast since the signing of the armistice. The rate has been $25,000 per month on a three months' basis, $23,000 on a six months' basis, and $20,000 for periods of one year or longer. It is reported that actual cost will be the basis for purchase.

New Ocean Rates

On February 13, the Shipping Board gave out a revision on ocean rates for both the Atlantic and Pacific coast service as follows: Japan, China, Manila, $12 per 2,000 pounds; Vladivostok, $25 per 2,000 pounds. Commodity rates for homeward cargoes will be established and quoted upon on application.

From the United States North Atlantic ports to Rotterdam, Antwerp, Havre and Bordeaux, $1.25 per 100 pounds, or 65 cents per cubic foot; Marseilles, Cette, Genoa and Naples, $1.60 per 100 pounds, or 85 cents per cubic foot; Barcelona, $1.85 per 100 pounds.

Rates from North Atlantic ports to Japan, China and the Philippines, $20 for close weight, $25 for all other cargo.

From South Atlantic ports the rate has been fixed at $1.07 per 100 pounds to Europe and the United Kingdom, increasing for other destinations with a maximum of $1,93 per 100 pounds to Barcelona, Spain; to Holland, $1.33; to Belgium and Italian ports, $1.68.

Navy Programme Passes House

On February 11, the House of Representatives approved the new three-year building programme of ten battleships and ten scout cruisers for the navy.

To Install Falk Gears on Submarine Boat Corporation's Vessels

In final conference with representatives of the Westinghouse Electric & Manufacturing Company, Director General Piez has made arrangements for the acceptance of twenty sets of turbine reduction gears offered by the Falk Company, of Milwaukee, Wis., to be used in outfitting vessels of the Submarine Boat Corporation in lieu of the Westinghouse gears. These sets, which will be delivered as rapidly as possible, will help speed up the outfitting of twenty-one hulls, which have been waiting for machinery at the Submarine Boat Corporation's yards for three months.

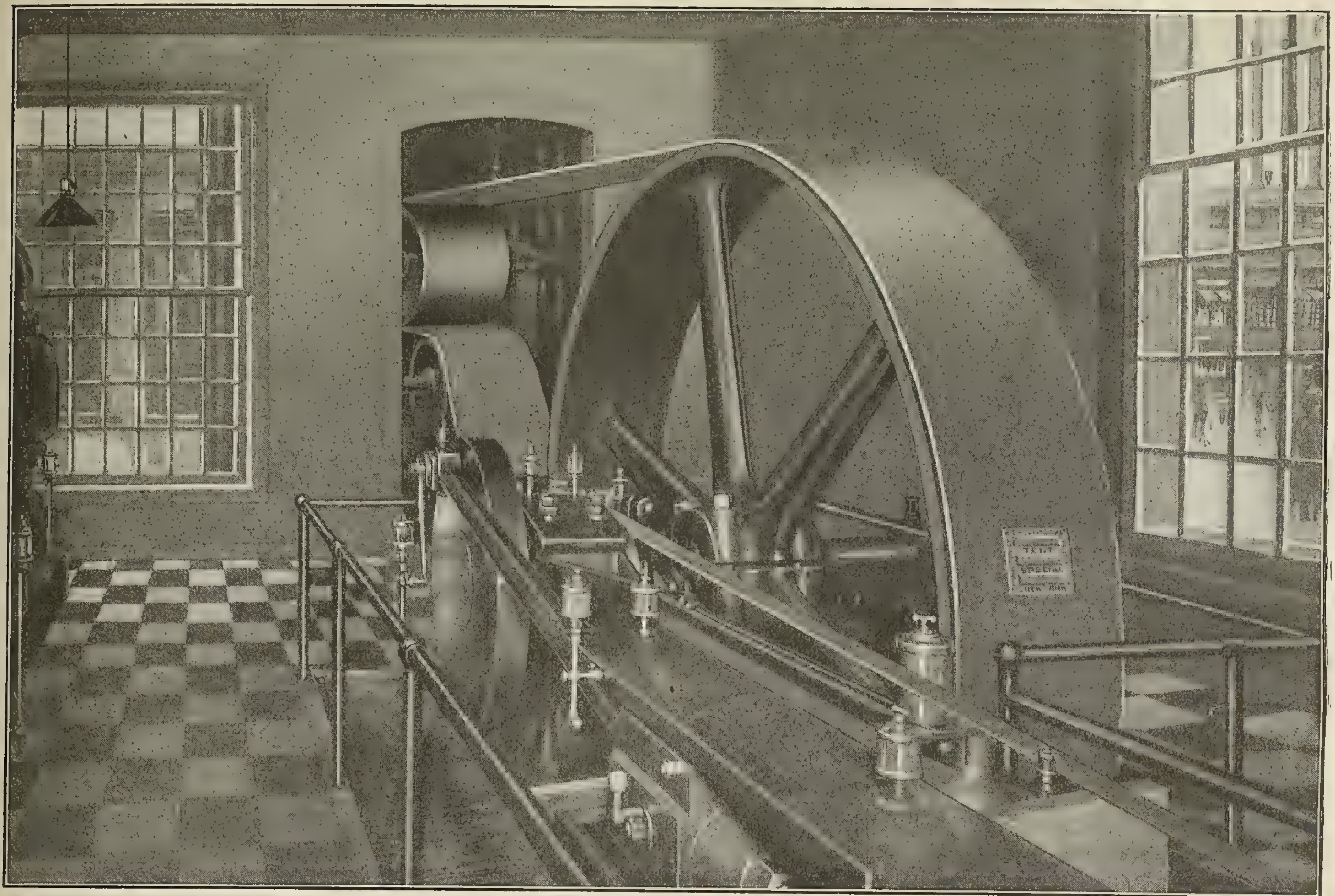
In the meantime the Westinghouse designers are correcting the defects which developed in the first gears. Westinghouse representatives report that shop tests prove that the changes already made in the gears will make them entirely satisfactory.

Foreign Trade Convention Meets in Chicago in April

James A. Farrell, president of the United States Steel Corporation, announces that the Sixth National Foreign Trade Convention will be held in the Congress Hotel, Chicago, on April 24, 25 and 26. The relation of the merchant marine to the extension of foreign trade will be discussed in several papers. For the benefit of the delegates a large amount of valuable technical information has been compiled, which is based on the experience of prominent business men in every branch of foreign trade.

Baltimore Bids for Shipping

The city of Baltimore is inaugurating a campaign to divert shipping to that port. Among the advantageous features mentioned are the following: Baltimore is 155 miles nearer Chicago and the Middle West than any other port city, which has been the reason for the



decree of the Industrial Commerce Commission covering the freight differential in favor of the city; it possesses a 35-foot channel at mean low water 60 feet wide; the harbor is landlocked; no port charges of any description are permitted; three direct railroad lines connect with it; coal is delivered at Sparrow's Point at 20 cents per gross ton less than at Bethlehem, Pa.; gas and electricity are cheaply supplied. Those interested should communicate with James H, Preston, Department 22, City Hall, Baltimore.

Want Permanent Labor Adjustment Board Established

A meeting of the Administrative Council of the Atlantic Coast Shipbuilders' Association was held at the Bellevue-Stratford, on February 17, to discuss a definite plan for the establishment of a labor adjustment board to perform the same function as the Macy Board, which will automatically go out of existence on March 31. It was stated that sentiment seemed to be crystallizing in favor of establishing a Government adjustment board, to be organized with the approval of both shipowners and shipworkers to settle difficulties which may arise between them.

A report was submitted on February 12 to Vice-President Marshall by shipworkers of the various yards from Maine to Galveston, including the Great Lakes. Their programme, as summarized, called for: (1) Immediate cancellation of the pending $62,000,000 contract with Chinese yards, and $100,000,000 contract with Japanese yards, to transfer the building to American plants; (2) the continuation of a construction programme which would make America's merchant marine and navy second to none; (3) the provision that workmen from yards which may be temporarily slack in work be provided transportation to their homes and other jobs.

Manager of the Washington office of the Atlantic Coast Shipbuilders' Association, John B. Carroll, is continuously in touch with all departments of the Government and the Shipbuilding Labor Adjustment Board, and is ready to assist members of the association at all times.

Labor Unrest During February

With the shipbuilding industry going at full speed, the labor organizations throughout the world have taken the opportunity to gain demands which, under ordinary working conditions, would hardly be attempted. On the Clyde, 20,000 men were standing out for shorter hours. In Belfast, although the workers were quite unwilling to strike, particularly those who are not new in the industry, all shipworkers were idle.

In Seattle and Tacoma conditions were much the same, the demands being proposed by the newer element. Here 25,000 men were involved, the more skilled trades, including the metal workers, inciting the action. The companies' hands were tied, since the basis of the contracts upon which the men are now working has been determined by the Macy wage agreement, to which the workmen failed to agree. In Seattle the yards lost the opportunity of repairing the *Admiral Watson*, which was sent to British Columbia, and were also unable to deliver, among other vessels, the four cargo ships purchased by W. R. Grace & Co. In Oakland, labor passed resolutions for a six-hour day, but did not act.

The East and South were also involved. The metal workers at New Orleans, 8,000 at least, finally returned to work. Coppersmiths at the Norfolk Navy yard were also dissatisfied with their present working conditions. At Savannah, disturbance was expected at the yards of the Foundation Company. In all these districts shipyard workers were scarce. Hog Island has advertised daily for fitters and other accessory workers. At Groton, Conn., although a dissatisfied employee tried to create unrest, the shipworkers kept steadily at work, as have the men in Maine.

The fact that these conditions could exist throughout the country when at least 135,000 men were unemployed, according to the figures of the United States Employment Bureau, shows that shipyard work is either distasteful to the general skilled laborer, or that unnecessary agitation is being fomented at this time. The men in the older yards have been less anxious to join in the strike, which may be an indication of their interest in the future of the industry.

HELP AND SITUATION AND FOR SALE

☞ No advertisement accepted unless cash accompanies the order.

Advertisements will be inserted under this heading at the rate of 4 cents per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent per word. But no advertisement will be inserted for less than 75 cents. Replies can be sent to our care if desired, and they will be forwarded without additional charge.

Wanted—Several first-class marine, piping and detail draftsmen. Apply *Terry Shipbuilding Corporation*, Savannah, Ga.

Assistant Naval Architect, with firm building 50,000 D. W. tons per yard, desires inside position with substantial yard on West Coast. Address *West Coast,* care of MARINE ENGINEERING.

Draftsman Desires Change — Has had fourteen years' varied experience, as follows: Gasoline engines, tool work, automatic machinery and hull, mechanical. Address *Box* 57, care of MARINE ENGINEERING.

Hull Draftsman, with nine years' experience in naval and merchant work, desires position. West Coast or Japan preferred. Scientific or structural. Two years' supervisory. Address *Box* 156, care of MARINE ENGINEERING.

Wanted—Experienced marine engine draftsman, permanent position. Apply by letter only, stating age, nationality, experience, salary wanted, married or single, *Power Specialty Company,* 111 Broadway, New York.

Naval Architect of twenty years' experience has facilities, and can devote part time to ship design, plans or appraisal, or represent shipping or shipbuilding interest in vicinity of Philadelphia. Address *Box* 210, care of MARINE ENGINEERING.

We want to buy volumes and copies of INTERNATIONAL MARINE ENGINEERING, American Society of Naval Engineers, Society of Naval Architects, U. S. Naval Institute, Rudder, etc. *International Magazine Company,* Elizabeth, N. J.

Mechanical Engineer, with twelve years' experience on marine work, desires change. Employed with Shipping Board since war started, but wishes to return to commercial work. Particularly experienced in the design of reciprocating, steam and Diesel engines and auxiliaries. Graduate of leading university, in both mechanical and electrical engineering. Address *Commercial Work,* care of MARINE ENGINEERING.

For Sale—Tug W. H. Williams. Iron hull, 90' x 19' x 10'; boiler, 10' 6" x 12' 6"; engine, 15 x 28 x 22; bunker capacity, 25 tons. Equipped with condenser, steam steering gear, two steam capstans; electric lights throughout. Entirely rebuilt in 1917 and in first-class condition. Address *Tug,* care of MARINE ENGINEERING.

For Sale—Two 360-H. P. Duesenberg Marine engines, new, 8 cylinders, 6¾" x 7¾", each $5,000. Also a 72-foot new motor boat, equipped with three of these engines; speed 35 miles an hour; cost $52,000. Our price, $35,000. Address *Engines,* care of MARINE ENGINEERING.

Executive Engineer, experienced in entire charge of hull and machinery, plant layouts and equipment, superintendence and erection. Good references; go anywhere. Responsible position only. Address *Box X,* care of MARINE ENGINEERING.

Naval Architect and Marine Superintendent, graduate; five years' ship drafting, two years' steel ship construction, twelve years' supervising work in ship drafting office and shipyard, open for permanent engagement. Address *Box* 630, care of MARINE ENGINEERING.

There is not a shipyard in this country that is managed and operated on the principles that have been proved sound in the most successful industrial and manufacturing concerns. I can solve your shipbuilding problems. Big production at low cost. Address *Shipbuilder,* care of MARINE ENGINEERING.

Young Man, aged 24, with technical education, five years' experience as engine draftsman, estimator and charge man, now employed in Gulf Coast yard as chief draftsman, is open for position with East or West coast yard. Holds first assistant engineers' license. Is married. References. Address *Gulf Coast,* care of MARINE ENGINEERING.

Construction Engineer—Young man, graduate engineer, seven years' structural engineering experience. For the past two years in responsible position for the United States Navy Department in one of the large Eastern shipyards. Thoroughly acquainted with detail, purchasing and inspection work of engineering materials. Highest references. Address *Construction,* care of MARINE ENGINEERING.

Marine Refrigeration — All-around Engineer, Practical and Technical, with many years' experience, marine (and land), with leading British firms, CO_2 and NH_3 systems, and all classes of cargo and provision carrying, who have ORIGINATED CO_2 refrigeration with British firm, desires post with American engineers to commence refrigeration in new shipbuilding. Can carry job through, *i. e.,* estimation, design (on blank sheet, not copy), manufacture, erection, running, etc. Address *Marine Refrigeration,* care of INTERNATIONAL MARINE ENGINEERING, 8 Bouverie street, London, E. C. 4.

We Want Three Live Salesmen—One for each of the following divisions of our business: One man to represent us in the shipbuilding and ship chandlery trade; another to look after the export trade in New York City, and one calling on the heavy hardware jobbers. These three men must have the confidence of the principal buyers in their respective line and experience to guide them in locating customers who are in the market for our product. We will assist them by carrying full-page advertisements in three of the most far-reaching trade journals in the country, together with a direct mail appeal. If you are connected with a reputable house we want you to represent us on a commission basis, selling our product as a side line. Address *Tackle Block Manufacturer,* care of MARINE ENGINEERING.

The McCabe Pneumatic Flanging Machine is the subject of a bulletin published by the McCabe Manufacturing Company, Lawrence, Mass. "Make your shop more efficient and more dependable. Get away from the old-time and unreliable method of hand flanging by installing a McCabe pneumatic flanging machine. The McCabe will flange sheets cold ½ inch or under in thickness. This feature saves lost time waiting for heats—insures maximum production per man unit. With only two men, this sturdy and powerful machine will flange six complete locomotive flue sheets in one day—and they are flanged mechanically correct, too. With a McCabe in your shop you need have no thought of important work being held up on account of workmen laying off. The McCabe is always on the job. May we describe some comparative jobs?"

The Value of the Automatic Compensator, made by the Electric Controller & Manufacturing Company, Cleveland, Ohio, is explained in a bulletin just issued. "A great many machines are only in actual operation part of the day. This applies to emery wheels, circular saws, etc. There is no one selected to start and stop these machines every time they are used. As a result they generally run during the working hours. With the EC&M Automatic Compensator the push button can be mounted on the machine or controlled by a foot pedal, and anyone can start and stop the motor. A plant had one large room with a number of operators working at machines, all of which were driven by one motor. Once in a while a belt came off or some accident occurred, and it was necessary to send for a mechanic, and after that for the plant electrician to start the motor. As soon as the EC&M Automatic Compensator was installed, push buttons were located at various points around the room. The motor can be started at only one push button, but can be stopped at any push button."

"Armco" Iron Filler Rods for welding sheet metal parts are described in a circular issued by the Page Steel & Wire Company, 30 Church street, New York. "The economic saving and desirability of welded seams and fittings over the older method of riveting is now beyond question. The Electric Welding Committee of the United States Shipping Board conservatively estimates the saving on hull plating and other vital ship parts at 25 percent. On minor ship parts the labor saving is estimated to be from 60 to 70 percent. In the manufacture of boilers, plate shells, pressure containers, sheet metal pipe and the like, the saving in time, labor, material, the reduction in weight, etc., all indicate that welding is the approved construction for the future. Armco Iron is a particularly desirable filler for welding seams of and attaching fittings to sheet metal surfaces and containers for the following reasons: 1. Uniform purity and metal structure that produce welds of the highest efficiency and permit the standardization of repetitive welding operations with absolute reliability of the finished welds. 2. Free flow and action under heat, that make the operative's work easy and give him greater confidence. 3. The standardization of one metal composition in two tempers to meet all ordinary iron and steel requirements. Armco iron rods for oxy-acetylene are the same as for electric welding except the temper, which for electric is harder to work equally well under the higher temperatures. 4. Readily obtainable in all popular sizes from conveniently located supply depots in all industrial centers. Write for a trial shipment, and if you want free advice on welding subjects, your questions will be answered by engineers who have made welding a life study, and who know from first-hand experience what is being done in this line."

Correct Illumination is the subject of a bulletin just published by J. Livingston & Company, Grand Central Terminal, New York. "We show herein various designs of lighting fixtures and reflectors, selected as a result of many years' careful and patient investigation and experience as constructing engineers, designers and manufacturers of electric light and power systems. The fixtures and reflectors shown are specially designed to correctly illuminate factories, mills and all types of industrial buildings. The shape and size of every reflector has been decided upon after careful study from the standpoint of efficiency, durability and perfection in design. The material used in their manufacture is highly tempered steel porcelain enameled, which is a permanent and durable finish, not being affected by heat, cold or the most rapid change in temperature. The importance of this, especially as it applies to the white enameled reflecting surface, cannot be overestimated. It does not crack, peel or become discolored. It can be washed, scoured and cleaned in the most rigorous manner possible without fear of injuring the enameled surface. It is quite impossible to do this with any other surface finished reflector without destroying its high reflective powers."

Rome Hollow Staybolt Iron is described in a circular issued by the Rome Iron Mills, Inc., 30 Church street, New York. "Rome Hollow is an iron that is made hollow at the right time—when the iron is made. Bars are rolled to standard length—12 to 16 feet. You make your own staybolts for each job in the old economical way. Rome Hollow is rolled by the Jenkins patented process. The same men, the same mill, give it the Rome superior quality you've known for fifty years. And remember, every bar is guaranteed."

The "Universal" Ladder Step, described for use on shipboard, is described in a circular published by the Universal Safety Tread Company, 40 Court street, Boston, Mass. "This ladder step is designed for use on shipboard for all types of naval and merchant vessels wherever an all-metal self-supporting safety tread step, suitably reinforced, is required, as well as for industrial purposes, power house or engine room stairs, and all other similar situations. It combines four most essential features —non-slip efficiency, strength and stiffness, light weight and rust-proof advantages."

The Lukens Steel Company, Coatesville, Pa., was the first to make boiler plates in America. This company has recently issued a circular from which we quote as follows: "Our new 204-inch mill, the largest mill in the world, is now in operation. We can furnish plates up to 190 inches in width. Change your designs by cutting out seams and take advantage of these widths. Can furnish 15-foot O. D. flange heads in one piece. Lukens steel is the leader for boilers and fireboxes of all types. One hundred years' experience. O. H. basic or acid, tank, bridge, structural and special specification steel. All plates straightened by specially patented rolls. Lukens 'Best Yet' manhole fittings. Our new patented manhole cover plate beats them all—no through riveted bolts. Meets all requirements of Steamboat Inspection rules. Every shop should have them in stock. Lukens flanging tops them all. Our flanging department is fully equipped with the best and latest machinery for turning out heads for all kinds of work. All sizes of flue holes. Can furnish irregular flanged heads by machinery, thus giving superior finish to the best hand or usual method of doing this class of flanging. Send in your inquiries and see what we can do. The Huston patent boiler brace is acknowledged by mechanical experts to be superior to any other brace on the market in quality, strength, lightness in weight, workmanship, general appearance and finish. Send for circular giving tests made."

Cutting Special Flue Sheets and flanges with a Davis-Bournonville radiograph and oxy-acetylene flame is described and illustrated in a circular issued by the Davis-Bournonville Company, Jersey City, N. J. "These 30-inch diameter flue sheets and 45-inch diameter flanges of 2½-inch plate were for special heaters required by the U. S. Government. Length of heaters, 11 feet 6 inches; diameter, 30 inches, each heater containing 85 tubes, 1½ inches in diameter. Oxy-acetylene welding and cutting with Davis-Bournonville apparatus was extensively employed to insure results not obtainable by riveted construction. Longitudinal seam of shell was welded, heads were welded to shell, and the 85 tubes welded into the heads or flue sheets. When finished, heaters were tested to 280 pounds hydrostatic pressure. The cutting of the heads and flanges by the radiograph constituted a large element of time saving and cost saving. The radiograph is an exclusive Davis-Bournonville development, and many of them are employed in steel mills, fabricating plants, shipyards and United States navy yards. Davis apparatus combines the widest and most complete range of equipment for oxy-acetylene and oxyhydrogen cutting and welding, including acetylene, oxygen and hydrogen generating and compressing systems, mechanical cutting and welding apparatus, hand cutting and welding outfits—portable and stationary, field and shop equipment. It leads the world in range, efficiency and number of successful users. Adopted by the United States army and United States navy yards. Apparatus and supplies for the largest installations or for the one-man outfit, of equal efficiency.

"The Chief Consideration in the Selection of Boiler Tubes is Durability," according to a bulletin published by the National Tube Company, Frick building, Pittsburgh, Pa. "The chief consideration in the selection of boiler tubes is durability—whether taken from the standpoint of durability under severe operative conditions, long usage, corrosive influences, or under the 'punishment' naturally received when beaded and rolled in the flue sheet. National lap-welded boiler tubes and Shelby seamless boiler tubes represent the highest standards of durability, because durability is the watchword of every man in the National Tube Company organization concerned with their manufacture. This striving to produce durable tubular products first manifests itself in the selection of high-grade ore, continues with the smelting and refining of the metal, is evidenced in the special manufacturing processes (such as Spellerizing, which minimizes any tendency to corrosion), and is concluded only when the tube successfully passes the final test and inspection before shipment. A high factor of durability has had much to do in establishing National and Shelby boiler tubes as the recognized standards of boiler tube quality."

Wire Rope Tackle Blocks are the subject of a booklet published by the Hudson Block Company, 149 Broadway, New York. "Hudson wire rope tackle blocks have the distinction of scientific distribution of strength, combined with quality and workmanship, produces a factor of safety enabling us to stake our honor on our products."

The Record of "85% Magnesia" in America's War Fleet is the title of one of the bulletins published by the Magnesia Association of America, 721 Bulletin building, Philadelphia, Pa. "The navy is always reticent as to its achievements, but gradually its part in the great war is becoming known. Little by little we are learning how America's ships and American sailors were responsible for the downfall of the submarine and the final surrender of the enemy fleet. When the full story can be told, it will be found also that '85% Magnesia' has fully maintained its reputation as the national coal saver and defender of steam. Every one of Uncle Sam's huge battleships, every American transport, and every destroyer has its pipes and boilers protected against heat leakage by an impenetrable armor of '85% Magnesia.' In the arctic weather of stormy Northern waters, amid snow and ice that often covered the decks and sides of the vessels for days at a time, through days of dark Atlantic gales, the fleet never failed in its mission, nor did the '85% Magnesia' covered pipes and boilers fail to deliver a plentiful supply of hot, dry steam to the engines."

A Medium-Heavy Duty Marine Motor is illustrated in a bulletin just published by the Knox Motors Associates, Springfield, Mass. "The Knox 40-H. P. marine motor is the latest product of a company whose engine building experience dates back for eighteen years. In its design and construction are embodied features that are the results of a careful study of the requirements of a successful marine motor. The materials entering into its construction have been selected with a view to giving maximum service with the minimum of attention. Alloy steels, special aluminum, bronze and iron alloys are used throughout, revolving parts are heat treated and ground to size with a glass-like finish. All rotating and reciprocating parts are carefully balanced. In fact, nothing has been left undone to produce the most perfect engine possible. We would call to your attention the full-pressure oiling system, which not only lubricates the entire motor but the reverse gear with all its bearings as well. No grease cups to bother with; the oil screen and adjustable by-pass are located above the engine ways; large hand holes in side of the case; two independent ignition systems, each with its own set of plugs; hot spot manifold, fully water-jacketed; separable cylinder heads, easily removable to permit of inspection and valve grinding; large reverse gear case cover permits access to any part of gear or its bearings."

Electric Traveling Cranes.—The Milwaukee Electric Crane & Manufacturing Company, Milwaukee, Wis., has issued a bulletin on the Milwaukee Crane. This bulletin shows a number of photographs of detail parts, as well as complete cranes and installation views. It also explains in detail a number of very decided improvements in crane construction.

Marconi Wireless Apparatus is described in a bulletin issued by the Marconi Wireless Telegraph Company of America, Woolworth building, New York. "Did you know that you can now rent or buy Marconi wireless apparatus—or buy it and still secure Marconi service? You can. So whatever the conditions you face you can enjoy the economy and safety and efficiency of wireless on your vessels and with the added and special advantages which only Marconi Wireless can give you. If you buy Marconi apparatus outright, you get the latest product of the world's leader in this field. If you contract for Marconi service under either rental or sales plan, you find every detail of operation charted for you; and wherever possible every burden or responsibility is transferred from your shoulders and pay roll to ours—all at a surprisingly modest fee. We will be glad to give you definite solutions of all wireless problems now, and we believe every shipowner will be interested in the details of our plan, sent gladly upon application to our nearest office."

"Thor" Universal Electric Drills are described in a bulletin just published by the Independent Pneumatic Tool Company 600 West Jackson Boulevard, Chicago, Ill. "Indispensable for all kinds of drilling, reaming and wood boring in the building of automobiles, steel and wood cars, boilers, auto bodies, and in railroad and structural shops, ship and drydock work and machinery repairs. The super-power motor is designed especially for the Thor drill, and possesses certain distinctive features resulting in extra power. It is absolutely impossible to stall a Thor drill on any work up to its full rated capacity. They will develop greater power than other drills weighing several pounds more. An aluminum crankcase on the small sizes insures lightness and convenience in handling and operating. The Thor is the only portable electric drill made with ball and roller bearings throughout, reducing friction to a minimum and increasing the efficiency."

Automatic Sprinkler Protection on Shipboard is the subject of a special bulletin published by the Marine Department of the General Fire Extinguisher Company, Providence, R. I. "Automatic sprinkler protection has never been largely installed on shipboard, because of certain vital objections raised by shipowners and naval architects. A new type of system, however, has been designed by our engineers which seems to meet all previous objections to this type of protection. This new system is dry pipe, and is still automatic. Water cannot be discharged on account of any accident to the piping system or the sprinkler heads. But water is instantly discharged in case of fire without any human aid. This new type of system makes a great advance in the art of automatic fire protection aboard ship. The type of fire protection that has reduced factory fire risks to practically nothing is now available to the shipowner. Send for our special bulletin giving greater details of this system. We are glad to submit plans, estimates and proposals without cost or obligation."

Chadburn Ship Telegraphs are the subject of a catalogue published by the Chadburn (Ship) Telegraph Company of America, Troy, N. Y. "The company's plant at Troy, N. Y., is manufacturing all ship telegraph material, engine counters, speed indicators, etc., for the mercantile service, the same as the works in Liverpool, England. We also have a Navy Department manufacturing special instruments for the United States Navy identical with the material manufactured by the Liverpool plant for the British Admiralty. The completeness and location of our factory assures prompt deliveries. We are prepared to give estimates for complete installations."

The Wilson Plastic-Arc Welder for use in shipyards and on board ship is described and illustrated in a circular just issued by the Wilson Welder & Metals Company, Inc., 10 Rector street, New York. "The splendid success of the Wilson Plastic-Arc welder in the repair of the German ships has started a general discussion of the advisability and practicability of adopting this method of welding for manufacturing purposes. A special meeting of the technical committee of Lloyd's Register of Shipping was recently held in London to consider this subject in connection with shipbuilding to the extent of eliminating by this method the use of rivets for important structural connections. The Wilson Plastic-Arc welder is as well adapted to manufacturing purposes as it is to repair work. It is very economical in operation, can be used to good advantage in the welding of metal parts of any character. It is also, of course, a ready-repair tool in the case of breakage or damage to cast iron cylinders, valve chests, pipe lines, engine bases and parts. Successful welds can be made in the open or in cramped, confined spaces—anywhere a man and a wire can go. All successful welding depends upon a constant uniform temperature at the weld. The more nearly constant the heat the better the weld. A steady, uniform, predetermined heat is always automatically maintained in Wilson Plastic-Arc welding."

MARINE SOCIETIES

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS
Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS
29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS
29 West 39th Street, New York City.

UNITED STATES NAVAL INSTITUTE
Naval Academy, Annapolis, Md.

AMERICAN ASSOCIATION OF MASTERS, MATES AND PILOTS
National President—John H. Pruett, 423 Forty-ninth St., Brooklyn, N. Y.
National Treasurer—A. B. Devlin, 187 Randolph Ave., Jersey City, N. J.
National Secretary—M. D. Tenniswood, 308 Vine St., Camden, N. J.

THE AMERICAN SOCIETY OF MARINE DRAFTSMEN
President—A. H. Haag, 5921 Walnut St., Philadelphia, Pa.
Vice-President—W. A. Leavitt, Jr., New York Shipbuilding Corporation, Camden, N. J.
Secretary—B. G. Barnes, 1596 North Ave., Bridgeport, Conn.
Treasurer—J. B. Sadler, P. O. Box 987, Norfolk, Va.

MARINE ENGINEERS' BENEFICIAL ASSOCIATION NATIONAL OFFICERS
National President—Wm. S. Brown, 356 Ellicott Square Bldg., Buffalo, N. Y.
National Secretary—Geo. A. Grubb, 356 Ellicott Square Bldg., Buffalo, N. Y.
National Treasurer—Albert L. Jones, 38 Avery Avenue, Detroit, Mich.

CANADA

GRAND COUNCIL, N. A. OF M. E. OF CANADA
Grand President—A. R. Milne, Kingston, Ont.
Grand Vice-President—E. J. Belanger, Bienville, Levis.
Grand Secretary-Treasurer—Neil J. Morrison, P. O. Box 886, St. John, N. B.
Grand Conductor—J. W. McLeod, Owen Sound, Ont.

GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND
39 Elmbank Crescent, Glasgow.

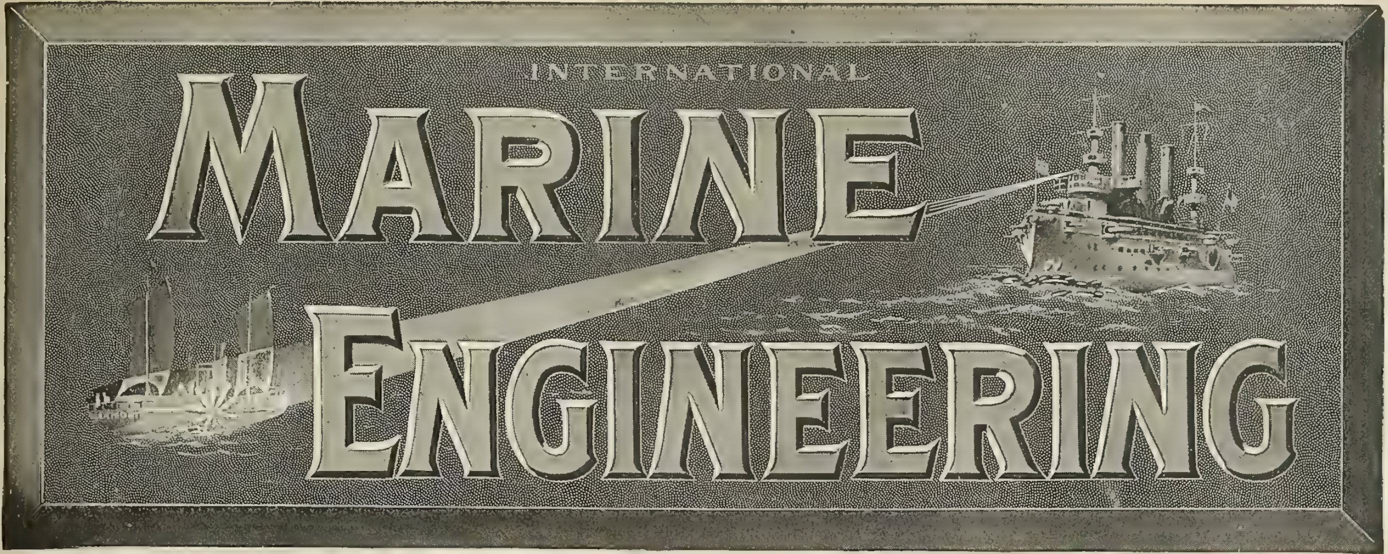
NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORPORATED
The Minories, Tower Hill, London.

ANNUAL SHIPBUILDING NUMBER

APRIL, 1919

44-4



Main Office: NEW YORK 6 East 39th Street

SUBSCRIPTION PRICE: Domestic, $2.00; Foreign, $3.00

LONDON OFFICE: 8 Bouverie St. E. C.

Germany Claims 4,700,000 Tons of Shipping

According to figures published in the *Cologne Gazette,* Germany still claims to be owner of 3,700,000 tons of merchant shipping, in addition to 1,000,000 tons constructed during the war. Of this total it is stated that 2,250,000 tons are in Germany or in the immediate neighborhood, with 750,000 tons or more untouched in neutral countries, and that 625,000 tons are temporarily confiscated. by neutrals.

Italy Builds Seven Large Liners

Three vessels of about 12,000 gross tons each are now under construction at the yards of the firm of Gio. Ansaldo & Company. The company also contemplates the building of four vessels of about 20,000 gross tons each, designed to make 20 knots.

Bridgeport, Conn., Plans Huge Harbor Development

The Chamber of Commerce, Bridgeport, Conn., has issued a report regarding harbor improvements in that city as recommended by Engineer Lindon W. Bates, who was retained to make a special survey.

He advised that the stretch of meadow between the mouth of the Housatonic River and the present Bridgeport harbor be utilized for the building of large manufacturing plants and for the new port development, the port operation to commence with the dredging of a channel and turning basin, and the construction of a rail line to the New York, New Haven & Hartford Railroad. It would first be practical, Mr. Bates reported, to build one pier on this site, to be supplemented, as rapidly as business demanded, by two other piers large enough to handle 9,000-ton steamers drawing 30 feet of water.

Mr. Bates has also recommended the development of the Black Rock section, which would necessitate the construction of two breakwaters, and would necessarily be more difficult of development than the previous site. It was emphasized that with the development of these facilities Bridgeport could handle part of the export and import trade which now passes through the New York harbor, and could also handle bulk freight which could be diverted to that port from the Poughkeepsie Bridge.

A temporary draft covering the financing of the port development has been submitted to the Connecticut Legislature, under the name of the "Port of Bridgeport Bill," which provides for the co-operation of the interested residents of Bridgeport and Stratford as stockholders in the new enterprise.

The following men have been appointed as the first board of Port Commissioners: Lieut.-Gov. Clifford B. Wilson, T. J. Pardy, Pardy Construction Company; Judge Howard W. Curtis; Sumner Simpson, president, Raybestos Company; Walter B. Lasher, president, American Chain Company; Samuel P. Senior, Bridgeport Hydraulic Company; George E. Crawford, former president, Bridgeport Chamber of Commerce, and Harold C. Lovell, town clerk of Stratford.

American Welding Society to Be Formed

A new association, to be known as the American Welding Society is being formed through a merging of the Welding Committee of the Emergency Fleet Corporation and the National Welding Council. Other men interested in the application of welding to shipbuilding, and, in fact, to all manufacturing processes, are also included in the new society.

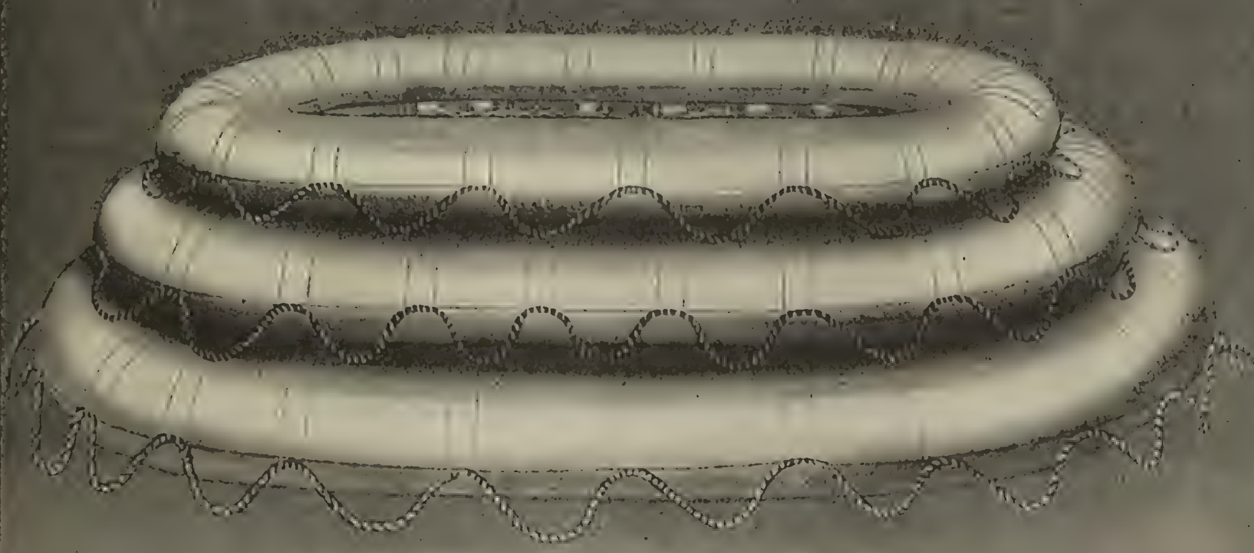
Scientific societies and experts in all the welding fields will be brought together to aid in the maintenance of a Bureau of Welding, which will be a separate organization, designed to carry on research and aid in the standardization of welding as a process.

The organization, through its dues, will provide funds for research, will superintend the carrying on of research, advance the training of expert welders, and serve as a medium to accomplish advantageous legislation and suitable publicity for the work.

The first meeting of the society will be held on Friday, March 28, at the Engineering Societies' building, 33 West Thirty-ninth street, New York.

SAFETY AT SEA

We do our bit in the manufacture of Marine Life-saving Appliances that will safeguard the lives of our officers, sailors, gunners and troops on ships going into the war zone



A nest of A. B. C. Life Rafts—Balsa Wood

For a great many years we have specialized in the manufacture of the highest grade of marine lifesaving equipment such as:

- Lundin Decked Lifeboats
- Lundin Motor Lifeboats
- Welin Quadrant Davits
- Norton Sheath Screw Davits
- Standard Metallic Lifeboats with "Steel Keels"
- Compensating Quadrant Cranes
- Metallic Cylinder Life Rafts
- Mills' Releasing Gear
- A. B. C. Life Rafts
- A. B. C. Life Preservers
- A. B. C. Ring Buoys
- Welin Gripe Release
- Welin Non-Toppling Blocks

Our policy is: "The best is none too good"

Catalog on Request

AMERICAN BALSA COMPANY, Inc.

Welin Marine Dept. **50 E. 42nd Street, New York**

London House: 5 Lloyds Avenue, London, E. C.

BUSINESS NOTES

The Cleveland office of the Chicago Pneumatic Tool Company has been located in rooms 406-408, Engineers' building, Cleveland, since March 1. Ross Watson remains district manager.

The following officers were elected at the organization meeting of directors of the Air Reduction Company, Inc., New York, held on February 19: A. S. Blagden, president; A. R. Ludlow, vice-president; C. T. Adams, treasurer; M. W. Randall, secretary; C. L. Snow, assistant treasurer, and C. C. Emerson, assistant secretary.

H. Lad Landau, general sales manager of Rownson, Drew & Clydesdale, Inc., 68 William street, New York, left in early March for a trip to San Francisco and the Far East to establish business connections there.

J. O. Norrie has become assistant manager of the Cunard office at Vancouver, B. C.

R. G. Ames has been made manager of the Chicago office of Black & Decker Manufacturing Company, 105 South Calvert street, Baltimore.

Since March 1 the Eastern branch of the Independent Pneumatic Tool Company has been located at 1463 Broadway, New York City.

Harry B. Hills has been placed in charge of the technical department of the Steward Davit & Equipment Corporation, 17 Battery Place, New York.

ACTIVITY OF THE SOUTH ATLANTIC MARITIME CORPORATION

Five Shipping Board Vessels Assured

The engineers, Monks & Johnson, Boston, Mass., who were commissioned by the South Atlantic Maritime Corporation to make a preliminary survey of the ports of Wilmington, N. C., Charleston, S. C., Jacksonville, Fla., and Savannah and Brunswick, Ga., have advised the construction of new terminals at these ports to be publicly owned. They propose that the terminals be located in positions accessible to the railroads entering the port, and be equipped with cargo cranes for loading and discharging ships. The engineers also advise the construction of warehouses adjacent to the piers, and the reservation of large tracts near the terminals for the development of industrial plants.

The corporation has already received promise of five ships from the Shipping Board for service between the ports mentioned and South America. Both outgoing and incoming cargoes are being booked by the representatives of the corporation for the first ship which will sail from Savannah on March 15.

To stimulate the development of the corporation, the company purposes to publish a magazine to be distributed through the South, Northwest and Middle West, and in the South American countries to which the vessels ply. By covering bankers, brokers, factories, manufacturers, importers and exporters in the circulation, the publication will help to build up extensive connections throughout the country. Inland offices have been established in the Munsey building, Washington, D. C., and in the Third National Bank building, St. Louis, Mo.

Canadian Shipbuilding Output

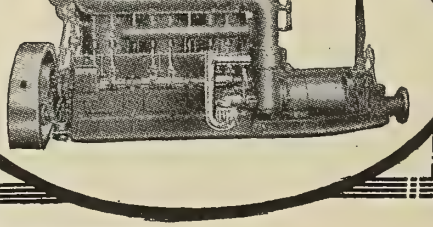
The following shipbuilding contracts are held by Canadian companies:

Number of Vessels	Size	Company
2	8,100	John L. Mullen Construction Company, Prince Rupert, B. C.
2	4,350	Port Arthur Shipbuilding Company.
2	2,800	Nova Scotia Steel Company, Nova Scotia.

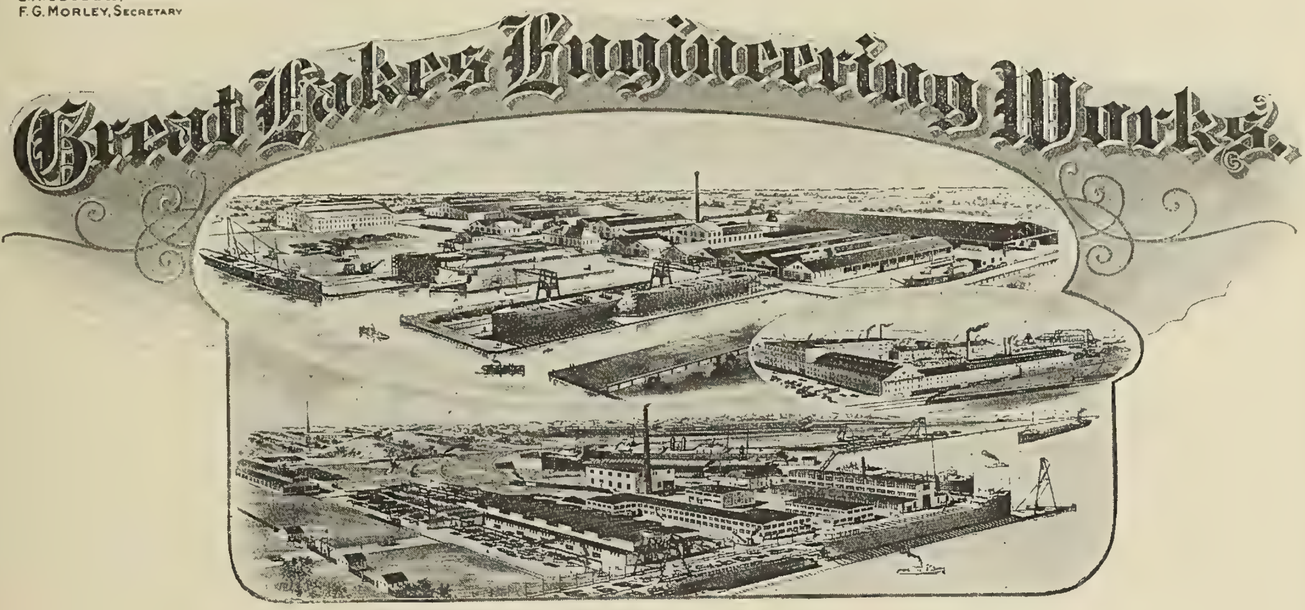
Providence, R. I., Will Have Large Marine Railways

As previously noted, a marine railway of the Crandall type is to be built by the Marine Engineering & Dry Dock Company at Providence, R. I. The contract for the driving of piles, the first step in the work, has been let to the Aberthaw Construction Company, Boston, Mass.

The marine railway, which will be the largest of its kind in New England, will be able to handle vessels up to 3,500 tons. The railway will be equipped with a crane and a spur track on the site. The work is scheduled for completion about the end of May.



ANTONIO C. PESSANO, Chairman of Board
JOHN R. RUSSEL, President
H. W. HOYT, Vice President & Treasurer
J. A. UBSDELL, Vice Pres. & Gen'l Manager
F. G. MORLEY, Secretary



Steel Ship and Engine Builders

Detroit, Michigan, U. S. A.

Over sixty steel ships have been built by us for over sea trade and forty-eight are now under construction.

French Government Permits Importation of Machine Tools

Chairman Bernard M. Baruch, of the War Industries Board, has cabled that the French Government is willing to allow sales to French merchants of $40,000,000 worth of machine tools and agricultural instruments, provided commercial credits for one year can be arranged.

To stimulate effective development of American export trade abroad, the American Manufacturers' Export Association is establishing communication with American chambers of commerce in other countries.

Meeting of the National Merchant Marine Association

The permanent organization of the National Merchant Marine Association was completed at the meeting of the association held in Washington, March 17 and 18. Senator Ransdell was elected president.

The five vice-presidents of the organization are J. Parker Kirlin, New York; Edward B. Burling, Washington; William Butterworth, Moline, Ill.; John H. Kirby, Houston, Tex., and William R. Wheeler, San Francisco. The executive committee elected follows: Edward B. Burling, chairman; George W. Norris and Capt. C. A. McAllister, Washington, D. C.; L. L. Richards and Hendon Chubb, New York; William Allen, New Orleans, and Emile P. Albrecht, Philadelphia. The executive committee will elect a secretary and treasurer.

The list of the members of the Council follows:

Hon. Joseph E. Ransdell (president), United States Senator, Washington, D. C.

H. L. Aldrich, publisher, Marine Engineering, 6 East 39th street, New York City.

Emile P. Albrecht, president, Philadelphia Bourse, Philadelphia, Pa.

William Allen, commercial representative, city of New Orleans, 331 Maryland building, Washington, D. C.

Fred Arn, president, J. M. Card Lumber Company, Chattanooga, Tenn.

H. V. Bernard, importer, 505 Fifth avenue, New York City.

J. L. Bernard, shipbuilder, 115 Broadway, room 604, New York City.

Harry A. Black, Galveston, Tex.

William S. Brown, president, National Association of Marine Engineers, 356 Ellicott square, Buffalo, N. Y.

Edward B. Burling, lawyer, Evans building, Washington, D. C.

W. A. Bowen, editor and publisher, Arlington, Tex.

William Butterworth, president, Deer Plow Company, Moline, Ill.

Hendon Chubb, underwriter, 5 South William street, New York City.

E. T. Chamberlain, Commissioner of Navigation, Washington, D. C.

T. F. Cunningham, vice-president, Board of trade, New Orleans, La.

Robert Dollar, president, The Robert Dollar Company, San Francisco, Cal.

Oscar K. Davis, secretary, National Foreign Trade Council, Hanover square, New York.

George S. Dearborn, president, American-Hawaiian Steamship Company, 8 Bridge street, New York.

Holden A. Evans, president, Baltimore Dry Docks & Shipbuilding Company, Baltimore.

John H. Fahey, president, St. John's River Ship Yard Company, 40 Court street, Boston.

P. A. S. Franklin, president, International Mercantile Marine Company, 9 Broadway, New York City.

Frank P. Glass, Birmingham, Ala.

C. E. Gunsky, civil engineer, San Francisco, Cal.

H. C. Hunter, secretary, Atlantic Coast Shipbuilders' Association, 30 Church street, New York City.

W. R. Ingalls, consulting mining engineer, Hill Building, New York City.

P. O. Knight, lawyer and shipbuilder, Knight, Thompson & Turner, Tampa, Fla.

J. Parker Kirlin, lawyer, 27 William street, New York City.

John H. Kirby, president, National Lumber Manufacturers' Association, Chicago, Ill.

Chas. S. Keith, president, Central Coal & Coke Company, Kansas City, Mo.

Alexander Legge, general manager, International Harvester Company, Chicago, Ill.

Edgar L. Luckenbach, steamship owner and operator, 44 Whitehall street, New York City.

Sumner Myrick, lawyer in charge Marine Transportation Bureau, Chamber of Commerce of the United States, Washington, D. C.

Captain C. A. McAllister, United States Coast Guard, Washington, D. C.

H. H. Merrick, Armour Company, Chicago, Ill.

T. F. Newman, Cleveland & Detroit Steamship Company, Cleveland, Ohio.

George W. Norris, commissioner, Federal Farm Loan Bureau, Washington, D. C.

J. K. Orr, Atlanta, Ga.

John H. Pruett, president, Masters, Mates & Pilots Association, 116 Broad street, room 61, New York City.

Commander W. V. N. Powelson, Overseas Transport Service, 61 Broadway, New York City.

H. H. Raymond, president Clyde Steamship Company and Mallory Steamship Company, New York City.

J. C. Rohlf, oil producer and exporter, San Francisco, Cal.

L. L. Richards, steamship broker; Director of Bureau of Transportation, War Trade Board, Washington, D. C.

F. L. Sanford, Southern Pine Association, Zona, La.

M. J. Sanders, steamship agent; Federal manager, Mississippi-Warrior Waterways, 1212 Hibernia building, New Orleans, La.

Ernest T. Trigg, president, Chamber of Commerce, Philadelphia, Pa.

Lieutenant-Commander Stevenson Taylor, president, American Bureau of Shipping, 66 Beaver street, New York City.

Eugene P. Thomas, president, United States Steel Products Corporation, 30 Church street, New York City.

Mathew Woll, American Federation of Labor, Washington, D. C.

Paul Wooton, Union Trust building, Washington, D. C.

H. A. Wheeler, banker; president, Chamber of Commerce of the United States, 7 South Dearborn street, Chicago, Ill.

TRADE PUBLICATIONS

A General Catalogue and price list is issued by the Kennedy Valve Manufacturing Company, Elmira, N. Y. In compiling the catalogue the company has endeavored to present all essential features in a simple and at the same time comprehensive manner. 122 pages; illustrated.

Marine Oakum is the subject of a bulletin published by the George Stratford Oakum Company, 160 Cornelison avenue, Jersey City, N. J. "More Stratford Special No. 1 marine oakum has been used by the U. S. Shipping Board Emergency Fleet Corporation of the Government than all other makes of oakum combined, and not a single bale has been condemned or rejected. This oakum receives the highest classification of the American Bureau of Shipping and Lloyd's Register of Shipping. Manufactured only by George Stratford Oakum Company, 160 Cornelison avenue, Jersey City, N. J.

Staybolt Taps are described in a catalogue published by the Pratt & Whitney Company, 111 Broadway, New York. "Like all P & W Small Tools, Pratt & Whitney staybolt taps are liked for their nice working qualities and their exceptionally long life of service. They're not only good when new but are heat treated and seasoned to maintain this goodness. Because they cut threads accurately and cleanly with the least expenditure of time and effort these taps are favorites in the shop. If you've used them before you know just how good they are. If you haven't, send us your first order—we know you'll be back for more. They're carried in stock in our sales rooms in all large cities, as listed here."

The Electric Tachometer, as installed in the United States Navy transports, is the subject of a bulletin published by the Electric Tachometer Corporation, 435 North Broad street, Philadelphia, Pa. "Install Tetco electric tachometers and have your engine speed right before you—always and anywhere —in engine rooms, chart house or on the bridge. No up-to-date vessels should be without them. Tetco Tachometers show direction of rotation and revolutions per minute instantaneously and accurately within 1 percent. They are easily installed; take up little room and require practically no maintenance. The photo shows one of fifty installations made for U. S. Navy transports. For our estimate sends us data regarding shaft diameter, maximum revolutions per minute and number and location of indicators."

The Benson Electric Telemotor is described in a catalogue published by the American Engineering Company, Philadelphia, Pa. "Electric control is the ideal form of transmission. It insures more sensitive control and greater ease of operation than any other. It relieves you of worry about air traps or temperature conditions. It eliminates the necessity of keeping a long line of shafting and gears in perfect alignment. Stretching will not in any way lessen its effectiveness, so that point need not worry you. It is so simple that it is almost impossible to get it out of order. It is very inexpensive in operation, because it uses a very small amount of current. Ask us to tell you more about the Benson Electric Telemotor."

"Repair of the German Ships" is the title of a booklet published by the Wilson Welder & Metal Company, Inc., 10 Rector street, New York, a copy of which will be sent to any of our readers upon request. This booklet tells how the Wilson Plastic Arc Welder made possible the repair of the seventy cast iron cylinders and other parts of the interned German ships—"the biggest welding repair job in the history of the world." "The use of a Wilson Plastic Arc Welder makes riveting of condensers and tanks unnecessary, and many shipbuilding and industrial plants have been quick to take advantage of this economy. It is an economy, because welding can be done at approximately half the cost of riveting, and while riveted seams let go and become leaky, necessitating welding as a second operation, Wilson welded seams hold, and hold tight, making a second operation unnecessary. The Wilson Plastic-Arc Welder will lastingly weld any metal of any bulk as successfully as it will steel or iron plate. The great success of the Wilson Welded in making lasting welds on the 9-foot cast iron cylinders of the German ships, and also in numberless other cases, is due to the fact that the critical heat at which the metal should be fused is kept constant at the arc. This predetermined, critical and constant heat eliminates the possibility of burnt metal or voids, resulting in failure, common of welds when the critical heat cannot be controlled."

The Graton & Knight Manufacturing Company, Worcester, Mass., oak leather tanners and belt makers, has got out a finely illustrated catalogue in two colors, showing the different processes of belt making from the receiving of the hide right through to the finished belt. This catalogue consists of 124 pages and cover, besides a special three-page insert of the factory. It not only illustrates and describes the different products made by Graton & Knight, but shows what can be accomplished with unsurpassed facilities for the manufacture of high-grade leather belting and leather specialties. The belting section fully explains the characteristic qualities, the particular differences and the capabilities of their different brands of belting. It also embodies mechanical rules, tables and other information which should be of value in determining the most efficient belt for any drive or in assisting with other transmission problems. The Graton & Knight Manufacturing Company is the manufacturer of the Standardized Series Leather Belts which have been advertised extensively in the national and trade fields. Besides the belting the company also make cup packings, pump leathers, automobile leathers, blanket straps, trunk and suitcase straps, trunk handles, halters and other leather products, such as insoles, outsoles, counters, box toes and Goodyear welting for the manufacture of shoes. The Graton & Knight Manufacturing Company will furnish anyone interested with a copy of this catalogue.

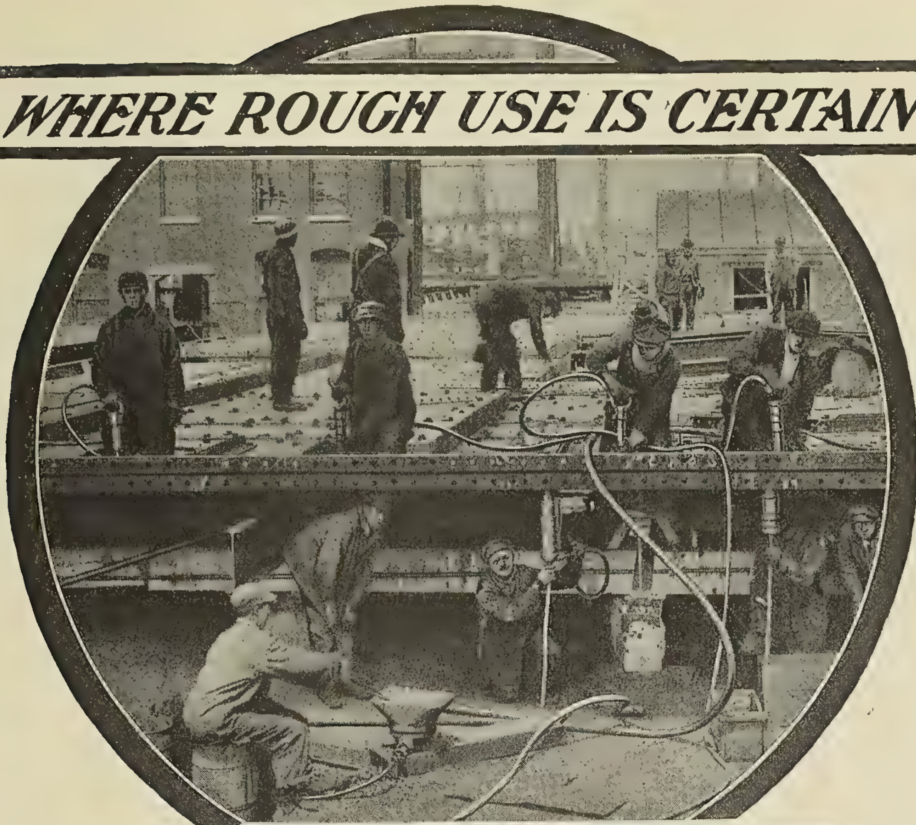
Loud-Speaking Marine Telephones are described in a circular issued by Klaxon Company, Department C-5, Industrial Division, 33 West Forty-second street, New York. "For peace-time price competition install loud-speaking marine telephones. Install them on your ships between the bridge and the engine room, between the bridge and the crow's nest and between the forward and after bridge. Klaxon-Stentor loud-speaking marine telephones are quicker, safer and more dependable than voice tubes. Let our engineers submit estimates on your contemplated voice tube installations. Loud-speaking telephone equipments might save you money."

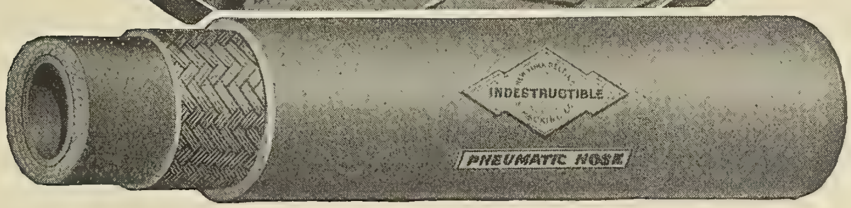
"Airco" Generators are described in a catalogue published by the Air Reduction Company, Inc., 120 Broadway, New York. "Airco generators can be operated in only one way—the right way. Airco generators are on the approved list of the National Board of Fire Underwriters. Airco generators are of the carbide to water type, and use 1¼- by ⅜-inch carbide, assuring a maximum gas yield and low, even generation without pressure fluctuation. Because of the Airco type of feed, the carbide is evenly distributed over the surface of the water, and insuring cool gas of a high quality, which can be obtained only under these ideal conditions. The generation without pressure fluctuation. Because of the Airco type which is operated by the gas passing through it to the service pipe. There are no clock work, springs or weights to get out of order."

Riveting and Chipping Hammers.—Bulletin 101 has just been issued by the Duntley-Dayton Company, Westminster building, Chicago, being the first of a series of publications which this company has in preparation. It is devoted to the Duntley-Dayton line of riveting and Chipping hammers, of which there are twenty sizes and styles, and features their low cost of maintenance. Pneumatic holders-on, pneumatic rammers, rivet sets, chisel blanks, hose, hose couplings, grease and oil, and lead hammers for use in repairing pneumatic tools, are also presented. A view of the new plant of the Dayton Pneumatic Tool Company at Dayton, Ohio, whose entire output is handled by the Duntley-Dayton Company, appears on the front cover.

"Efficiency in Flanging" is the subject of a bulletin published by the McCabe Manufacturing Company, Lawrence, Mass. "Get away from the old-time and unreliable method of hand flanging by installing a McCabe pneumatic flanging machine. The McCabe will flange sheets cold ½ inch or under in thickness. This feature saves lost time waiting for heats—insures maximum production per man unit. With only two men, this sturdy and powerful machine will flange six complete locomotive flue sheets in one day—and they are flanged mechanically correct, too. With a 'McCabe' in your shop you need have no thought of important work being held up on account of workmen laying off The 'McCabe' is always on the job. May we describe some comparative jobs?"

WHERE ROUGH USE IS CERTAIN





When you buy pneumatic tool hose you pay least in the long run, if you buy long-lived hose. Otherwise any one of a dozen faults, common to cheaper grades, can delay a contract or hold up delivery. And that costs money.

Where rough use is certain, you'll do well to consider

"INDESTRUCTIBLE" PNEUMATIC TOOL HOSE

For there are a number of special features that make it best in its field.

First, there's an oil-proof, seamless inner tube that never works away from its wall of protecting duck. And that duck is three-ply rubber filled. Then there's a braided fabric jacket—continuously woven. It adds great strength. Lastly there's a thick rubber cover that's built to take punishment. It won't kink—you can't make it. And that's a huge time-saver itself.

It is one of many products built by pioneers in the mechanical rubber goods field which, by the manner of its making, cannot fail.

New York Belting and Packing Company

MECHANICAL RUBBER GOODS

Makers of "TEST SPECIAL" Rubber Belting

New York Boston Chicago Philadelphia Pittsburgh St. Louis
San Francisco

NEW YORK BELTING & PACKING CO. FOUNDED 1846 INCORPORATED 1856

Marine Forgings of all kinds are the subject of bulletins published by the Mesta Machine Company, Pittsburgh, Pa. "Every ingot used in the production of Mesta marine forgings is poured from steel made in the Mesta open-hearth steel furnaces. The forging department is equipped with Mesta steam hydraulic presses of large capacity, which assures a thorough working of the steel throughout its entire mass. The department for the finishing of shafts has a larger capacity and is equipped with more modern machinery than that of any other producer of forgings."

The Double-Helical speed reducing gear, as used for stepping down from the high speeds of steam turbines to speeds suitable for ships' propellers, direct-current generators, large centrifugal pumps and fans, rope and belt drives, etc., was first introduced about twenty-five years ago by the late Dr. De Laval. This type of speed-reducing gear has subsequently been developed and refined by the several companies bearing his name, particularly for large size units, by the De Laval Steam Turbine Company, Trenton, N. J. That company has now issued a 32-page catalogue describing standardized geared turbine units for marine service. The gain in fuel economy of the steam turbine over the reciprocating engine is stated to be approximately 25 percent. The geared turbine weighs about half as much and occupies less than a third of the cubical space required by the engine. It is also more accessible and easier to repair, the expense for supplies and attendance is considerably less. The new publication describes the details of construction of turbines and gears and also various turbine-driven auxiliaries, including lighting sets, circulating pumps, boiler feeders, etc. A new development is the centrifugal pump for the continuous purification of the oil used in the turbine and gear bearings and on the gear teeth.

"Boyer" Pneumatic Hammers are the subject of Bulletin No. 124, published by the Chicago Pneumatic Tool Company, 1044 Fisher building, Chicago, Ill. "The first successful pneumatic hammer placed on the market was the 'Boyer,' and the place it made for itself in the beginning has been held to this day. Sound principles in design, operating advantages that prove out in performance, and the service policy of its makers—all these contribute to the permanence of 'Boyer' prestige. The 'Boyer' is the hammer for your plant. Ask the men who are to use them. The 'Boyer' line of riveting hammers and rivet busters, in conjunction with the 'BK' line of chipping and calking hammers, presents an assortment from which any pneumatic hammer requirements may be accurately and properly filled. All parts of any particular tool are made absolutely interchangeable by the use of accurate jigs and templates."

Boiler Logic.—The Heine Safety Boiler Company, St. Louis, Mo., has just completed the latest edition of "Boiler Logic," an 86-page treatise on steam boilers. This treatise covers the following topics:

1. Some Fundamental Considerations of Boiler Design—
   - (a) Furnace Design Requirements: Mixing, Time, Temperature.
   - (b) Heat Transmission from Fire by Radiation.
   - (c) Heat Transmission by Convection.
   - (d) Heat Transmission Through Tubes and to Water.
2. Practical Baffling of Watertube Boilers—
   - (a) Flexibility of design.
   - (b) Leakage and cost of repairs and renewals.
   - (c) Active and inactive surface.
   - (d) Ease of cleaning soot and ash deposits.
3. Heine Boilers for Different Fuels, Firing and Services—
   - Hand Firing with Bituminous Coal.
   - Hand Firing with Anthracite Coal.
   - Chain Grate Stokers.
   - Underfeed Stokers.
   - Oil Fired.
   - Shavings and Refuse.
   - Bagasse.
   - Gas Fired.
   - Waste Heat Boilers.
   - Dredge Boat Boilers.
4. Overloads.
5. The Boiler as a Pressure Vessel.
6. Details of Construction, Heine Boilers.

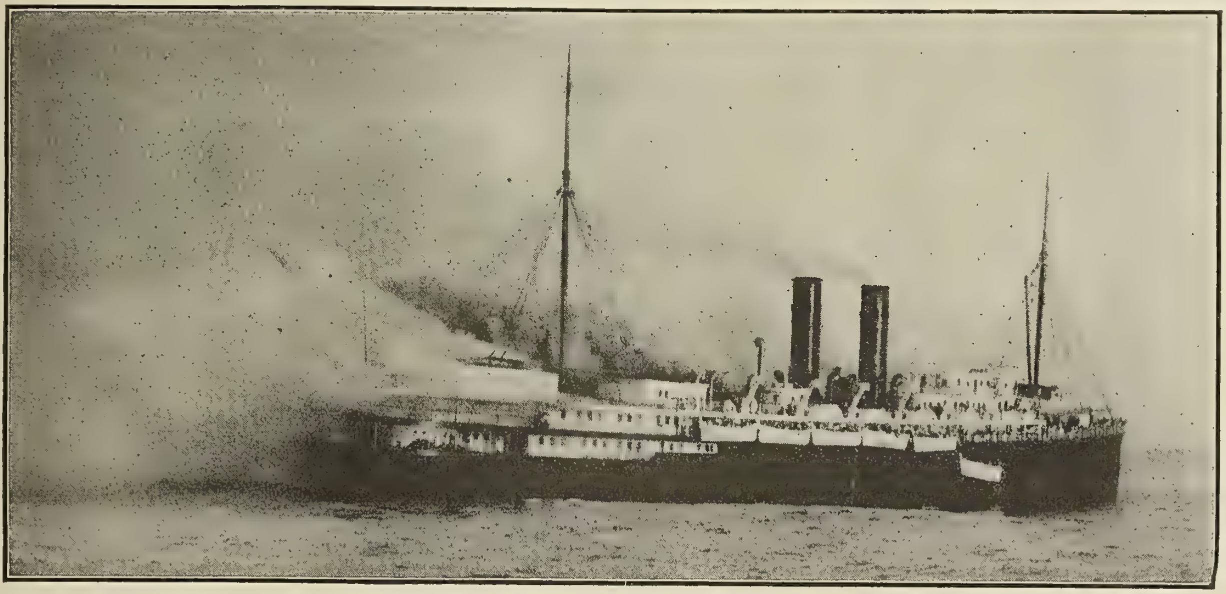


Photo from Underwood & Underwood

The "Fire-Gun" for Marine Use is the subject of a bulletin issued by the Fire-Gun Manufacturing Company, 115 Fourth avenue, New York. "The Fire-Gun puts out little fires before they get to be big ones. Fire-Gun is a new liquid pump which is positively double-acting from the first stroke until it is absolutely empty. Never pumps air; never sputters or drips, but shoots a solid stream 30 to 40 feet; will stand roughest usage; never leaks nor fails to operate. Fire-Gun holds 25 percent more fluid than other hand extinguishers, and this extra fluid often saves the day. Fire-Gun Fluid is effective where water is useless; it will not deteriorate; it is a non-conductor of electricity; does not freeze at 50 degrees below zero, and will not damage machinery or delicate fabrics."

"Little David" Pnuematic Tools are described in the "Little David" catalogue published by the Ingersoll-Rand Company, 11 Broadway, New York. "If you will watch a 'Little David' tool at work you will see that it is more speedy than others—enough so to justify its use on that ground alone. But if you measure the air consumed, you will find a power saving per unit of work—and continued service will show a marked decrease in the item of lost time due to breakage and expense of spare parts. Superior design and methods of construction make 'Little Davids' the most economical air tools. The 'Little David' catalogue tells all about them. Ask for a copy."

The Ryerson High-Speed Friction Saw and other machinery for the shipbuilder is described in Bulletin F, published by Joseph T. Ryerson & Son, Chicago, Ill. "The Ryerson High-Speed Friction Saw cuts all steel shapes used in the construction of ships in the quickest possible time. Many shipbuilders in all parts of the world to-day are using this saw with complete success. Write for complete information and Bulletin F, also complete literature on machinery for the shipbuilder."

"Something New in Hollow Staybolt Iron" is described by Joseph T. Ryerson & Son, Sixteenth and Rockwell streets, Chicago, Ill., in a bulletin just published. This iron, "Ulster Special," is described as follows: "Seamless—the only hollow iron without sections, longitudinally welded to secure the hollow feature. Every bolt length guaranteed not to split in heading, threading or driving, increases boiler shop output, reduces shop cost. All made from solid finished bar of identical 'Ulster Special,' that is standard for staybolts on majority of leading railroads. Manufactured from finished bar without further heating or working; a tough, ductile and uniformly dependable iron insured. Locomotive time lost in the shop is costly—one protection is seamless hollow staybolt iron. Exact staybolt lengths furnished—saves cost of cutting, eliminates waste, facilitates handling. Sizes in stock for your rush requirements without extra charge; manufacturing facilities insure prompt shipment. Specify seamless hollow iron —insist on 'Ulster Special'—there is no other hollow iron that is seamless."

The "Fulflo" Duplex Circulating Pump is described in a catalogue published by the Fulflo Pump Company, Blanchester, Ohio. "Made in any desired capacity. Methods of holding devised to suit the installation conditions of the engine to which they are to be applied. We also manufacture Flocontrol, bilge pumps and centrifugal pumps for water circulation and for bilge pump purposes. All of these pumps absolutely retain their prime without aid of valve, and may be placed above the level of the liquid where desired."

"Urite High Speed Steel' is the title of a booklet published by the Hercules Electric Steel Corporation, 137 Lafayette street, New York. "Urite High Speed Steel is a comparatively new product of the electric furnace, and contains besides tungsten, Vanadium, chromium, manganese, silicon and carbon, the important element uranium. In order to comply with the wishes of many of our friends we have published this catalogue, which gives a detailed description of the properties, manufacture, treatment and uses of Uranium High-Speed Steel. * * * Uranium is best introduced into the steel through the medium of an electric furnace. By means of this process the analysis of the steel is under absolute control. The well-known cleansing properties of the electric furnace, together with those of metal Uranium, give as pure a steel as it is possible to obtain. With a *pure* steel obtained by the electric method, and because of its Uranium content, we can with assurance say that Urite High-Speed Steel is second to none in the market at the present time. In many cases it will last twice as long as any other steel."

HELP AND SITUATION AND FOR SALE

No advertisement accepted unless cash accompanies the order.

Advertisements will be inserted under this heading at the rate of 4 cents per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent per word. But no advertisement will be inserted for less than 75 cents. Replies can be sent to our care if desired, and they will be forwarded without additional charge.

For Sale—Dismanted Wooden Tugboat; hull, 110 feet long 22 feet beam, 11.6 feet depth. Apply *Purchasing Agent*, L. I. R. R., Pennsylvania Station, New York.

For Sale—One Wheeler Admiralty type Surface Condenser, 1,080 square feet cooling surface, and complete with 12 x 14 x 14 x 14 combined air and circulating pump. Condenser is in good operating condition and being displaced by larger unit. For further particulars address *Texas Star Flour Mills*, Galveston, Tex.

Shipbuilder—Open for suitable responsible position; last employed as Superintendent of hull construction; capable man in drafting office. Over 20 years' varied experience, principally on small and light draft river work. Address *Box* 779, care of Marine Engineering.

Marine Engineer and Draftsman, technical graduate with over eleven years' experience in shipbuilding, of which seven years with American yards, desires responsible position here or abroad. Speak Italian and Spanish. Address *Box* 7, care of Marine Engineering.

Superintendent, with broad, practical shipyard experience, covering yard, shops, outfitting, drawing office and administrative departments, seeks position of responsibility where a good executive and organizer who is energetic and capable is needed. Address *Box* 42, care of Marine Engineering.

Position Wanted as Chief Engineer of shipyard or plant building marine engines or marine equipment. Now holding position of responsibility with large shipyard. Am thoroughly capable, energetic and a good executive. Have eighteen years' practical shipyard experience. Address *Box* 98, care of Marine Engineering.

Position Wanted—Assistant to general superintendent of steel shipyard, thoroughly familiar with ship construction and repair work, executive ability, technical training, practical experience in mold lift, ship fitting, erecting and fitting out. Address *Box* 725, care of Marine Engineering.

Wanted—Position as Purchasing Agent; sixteen years' experience—eight years railroad, eight years shipbuilding. New construction and reconstruction work. First-class references. Address *Purchasing Agent*, care of Marine Engineering.

General Superintendent or General Manager available, capable of taking charge of an up-to-date shipbuilding company; covering new construction and repairs. Fourteen years' experience in yards of Atlantic coast and Great Lakes; capable of furnishing complete organization; thirty-five years of age and married; references. Personal interview desired. Address *General Superintendent*, care of Marine Engineering.

Ship Repairer, Builder, Naval Architect, Marine Engineer and Estimator, twenty years' experience in steel shipbuilding in all its branches, desires responsible position with established shipbuilding or repairing plant. Up-to-date methods, coupled with economy for quick handling of large repair and conversion jobs. Experience in naval as well as all kinds of mercantile craft. Age 36; would go anywhere. Address *Box* 998, care of Marine Engineering.

Mechanical Engineer, with twelve years' experience on marine work, desires change. Employed with Shipping Board since war started, but wishes to return to commercial work. Particularly experienced in the design of reciprocating, steam and Diesel engines and auxiliaries. Graduate of leading university, in both mechanical and electrical engineering. Address *Commercial Work*, care of Marine Engineering.

Marine Refrigeration — All-around Engineer, Practical and Technical, with many years' experience, marine (and land), with leading British firms, CO_2 and NH_3 systems, and all classes of cargo and provision carrying, who have ORIGINATED CO_2 refrigeration with British firm, desires post with American engineers to commence refrigeration in new shipbuilding. Can carry job through, *i. e.*, estimation, design (on blank sheet, not copy), manufacture, erection, running, etc. Address *Marine Refrigeration*, care of International Marine Engineering, 8 Bouverie street, London, E. C. 4.

We Want Three Live Salesmen—One for each of the following divisions of our business: One man to represent us in the shipbuilding and ship chandlery trade; another to look after the export trade in New York City, and one calling on the heavy hardware jobbers. These three men must have the confidence of the principal buyers in their respective line and experience to guide them in locating customers who are in the market for our product. We will assist them by carrying full-page advertisements in three of the most far-reaching trade journals in the country, together with a direct mail appeal. If you are connected with a reputable house we want you to represent us on a commission basis, selling our product as a side line. Address *Tackle Block Manufacturer*, care of Marine Engineering.

Link Belt Silent Chain Drive is described and illustrated in a catalogue published by the Link Belt Company, Philadelphia, Pa. "Ten years ago the U. S. Rubber Reclaiming Company, of Buffalo, installed a 50-horsepower Link-Belt Silent Chain Drive. That drive has been operating ever since, 24 hours a day, carrying a 50 percent overload. If figured on the basis of a 10-hour day that drive has been in operation twenty-four years. Think of it! Twenty-four years of driving efficiency—unaffected by heat, cold or dampness, carrying 50 percent greater load than was intended—with never a slip, the load always cushioned and never a moment's idleness for chain repairs. That's Link-Belt Silent Chain Drive efficiency and service. It will prove itself 'flexible as a belt, positive as a gear, more efficient than either,' in your plant. Let us prove it."

"The Reilly Multi-Screen Feed Water Filter and Grease Extractor" is the title of Bulletin 609, just published by the Griscom-Russell Company, 2124 West Street building, New York. "Condensed steam from engine cylinders, heating systems, etc., is an ideal distilled water for boiler feed and many manufacturing purposes, provided it is freed from oil, grease and other foreign matter in suspension. If this oil, or material in suspension, is allowed to enter the boiler, it forms a coating on the heating surfaces, necessitating the burning of additional coal, and often resulting in severe damage. The Reilly Multi-Screen Feed Water Filter and Grease Extractor efficiently removes this oil from the water. It is also suitable for the removal of mud or sand from lake or river water when used for boiler feed."

The Ford "Tribloc" is described and illustrated in Catalogue 3, just published by the Ford Chain Block & Manufacturing Company, Second and Diamond streets, Philadelphia, Pa. "Dependable for heavy lifting. The Ford Tribloc, with its steel vitals, its positive, powerful, holding mechanism, is something more than a mere lifting tool; it is a hoist that may be depended upon greatly to exceed its rated capacity. All these are attributes of every Ford Tribloc, and they are kept in the pink of condition by reason of an independent dust-proof steel gear case and the damage-preventing loop hand-chain guide."

Small Tools are described in Cleveland Hand Book No. 6, published by the Cleveland Punch & Shear Works Company, Cleveland, Ohio. "In each successive step in the manufacture of Cleveland small tools—from the selection of material until the finished product leaves the workshop—great care is exercised to see that every tool 'measures up' to the same high standard which has during the past twenty-five years made an enviable reputation for Clevelands as the Dependable Small Tools. Cleveland small tools are 'made to make good'; therefore, when you specify Clevelands you are specifying small tools that are guaranteed to give maximum of service. Every punching machine should be adapted to use standard tools, as described in detail on pages 4-7 of Cleveland Hand Book No. 6. May we send you a copy?"

Cleveland No. 1 and No. 3 Wall Radial Drills are described by the Cleveland Punch & Shear Works Company, Cleveland, Ohio, in a bulletin just published. "The power raising and lowering device with which all Cleveland No. 3 Wall Radial Drills are equipped is conveniently located at the bottom of the standard column—is easily accessible and within the reach of the operator at all times. It governs a 6-foot vertical adjustment of the horizontal arm, and is operated by power obtained from the motive power of the machine. Cleveland wall radial drills can be furnished with either direct-connected motive drive or belt drive with countershaft."

G-E Apparatus at the plant of the Maryland Steel Company is described and illustrated in a circular published by the General Electric Company, Schenectady, N. Y. "G-E apparatus has a splendid record at the Maryland Steel Company. The double punch shown, with movable carriage, is but one of many applications of G-E motors at the shipbuilding plant of the Maryland Steel Company, Sparrow's Point, Md. Repeat orders year after year for a long time testify to the splendid satisfaction G-E motors and control devices have given under the exacting conditions met with in shipbuilding. Leading shipbuilding companies using G-E equipment find it is practically indestructible. A G-E motor made in 1893 is still driving the woodworking shop of the Newport News Shipbuilding & Dry Dock Company, which has also used the same G-E motors since 1897 to drive some of its big drydock pumps. Our engineers will be pleased to go over your power problems with you. This places you under no obligation."

"Why You Should Specify Chadburn" is the title of a circular published by the Chadburn (Ship) Telegraph Company of America, Troy, N. Y. "For scores of years our equipment has given the greatest satisfaction of *all* like equipment, until to-day more than 12,000 vessels and liners are carrying it exclusively. All vessels built at the Hog Island and Federal Shipbuilding Company yards are equipped with Chadburn products, as are the ships of the U. S. Navy and the British Admiralty. Engine and twin engine telegraphs, stokehold telegraphs, engine revolution indicators (speed), steering telegraphs, docking and lookout telegraphs, alarm gongs, engine counters, etc. We are prepared to give estimate for complete installations. Prompt deliveries. Send for catalogue."

Kelly Rocking and Dumping Grates are the subject of Grate Catalogue C and Foundry Catalogue G, published by the Kelly Foundry & Machine Company, Goshen, Ind. These catalogues state that Kelly Grates are the boiler makers' choice, and the reasons for this are stated to be as follows: Because Kelly knocking and dumping grates are backed by over twenty-seven years of experience; because Kelly rocking and dumping grates are simple, substantial, efficient, and are favorably known throughout the steam power field; there are no complicated parts to get out of order; they are easily installed, and we guarantee every set to give perfect satisfaction in the strictest sense of the word. Furthermore, our large output of grates and boiler fronts allows us to make you a price that is right. You should have both our Grate Catalogue C and Foundry Catalogue G, with prices, in your files."

Steam-Operated Lighting Generators are described in bulletins published by the A. R. Williams Machinery Company, Ltd., Toronto, Can. "The Watson engine generator equipment illustrated consists of a 7½-kilowatt Watson generator, direct coupled to a Type A American Blower Company high-speed engine. Speed 600 revolutions per minute, 110 volts direct current. Watson generators are built up to the highest electrical standards, carry substantial overloads, and are covered by the most full and complete guarantees. The A B C Engine is complete with cylinder, lubricator, automatic pump oiling system and auto fly-wheel governor."

Marine Lighting and Signaling Apparatus is described in an illustrated bulletin published by the Benjamin Electric & Manufacturing Company, Chicago, Ill. "If there is one place where absence of electrical trouble is absolutely essential it is on shipboard. And in Benjamin Marine Lighting and Signaling Apparatus this advantage is definitely procured. In the Benjamin line all parts are standardized, insuring utmost interchangeability. For instance, junction boxes may be installed and the receptacles, connecting blocks, or switches and covers may be mounted later, as the locations require. This also applies to fixtures—all parts are interchangeable. Such flexibility insures ease and speed of installation, convenience and protection in purchasing and absence of trouble when the ship is in service. We have just published a big illustrated catalogue covering all Benjamin electrical marine devices. You will find it interesting and thoroughly worth while. Write for a copy to-day."

"How to Stop Leaks" is illustrated in booklet 75-D, published by the Joseph Dixon Crucible Company, Jersey City, N. J. "All leaks of ammonia, steam and gas waste power at a time when it is the duty of every one to conserve in every possible way. Dixon's graphite pipe joint compound will effectually stop all leaks at joints in pipe lines. Simply because the graphite lubricates the threads and makes it possible to turn joints up tighter than usual. Conversely, graphite permits joints to be opened with ease at any time—no broken fittings—no wasted hours."

Plymouth Manila Wrecking Cable for floating stranded vessels is described in a bulletin published by the Plymouth Cordage Company, North Plymouth, Mass. "Plymouth Manila Wrecking Cable is a hawser-laid rope with plenty of elasticity and minimum unlaying tendency, very important requirements in the floating and salving of stranded vessels. These cables are made from selected grades of manila fiber, and possess extra strength and durability. They are consequently in popular demand and use in all waters. Salving of the American steamer *Redondo*, which recently went around at Dutch Point with a valuable cargo of nitrate from Chile, was successfully accomplished with the aid of two coils of 6-inch and one coil of 7-inch Plymouth Manila Wrecking lines, furnished through a distributor of Plymouth rope at Havana, Cuba. The estimated value of ship and cargo thus saved was $3,000,000, and Plymouth shares in the triumph accorded the contractor in Cuban press reports."

"'Armco' Iron Welding Rods" is the title of a booklet issued by the Page Steel & Wire Company, 30 Church street, New York. "The old theory that successful welding necessitates a choice of one from many compositions of welding rods was based upon the assumption that welding rods should have exactly the same composition as the material to be welded. Experience has shown this to be wrong. Seldom is it possible or practical to determine the exact composition of the material to be welded, and even if it were, the melting of the rod and metal in the presence of surface impurities, gases from the torch, etc., so alters the original filler composition that its true welding value is not the theoretical. The chemists, metallurgists and research engineers of the American Rolling Mill Company and the Page Steel & Wire Company spent years of profound study and experiment in determining the exact conditions existing and the transformations taking place. Their results and actual commercial experience in welding have proven that one composition of rod in two tempers, one for oxy-acetylene and another for electric welding, meets every requirement. The advantage of using Armco Iron Welding Rods of a single composition in two tempers is obvious. A shop doing general welding work, instead of having to carry stocks of many compositions, can meet all requirements from a small stock of Armco Iron Rods, that takes up small space and involves only a small investment. Give Armco Iron Welding Rods at least a trial, and you will be pleased with the first cost, ease of manipulation and reliability of the finished work."

An Angle Bar Planing Machine is one of the machine tools described and illustrated in a catalogue published by Hilles & Jones Company, Wilmington, Del. Capacity to plane 8-inch by 8-inch by ⅝-inch angles and smaller; to plane both edges of the angle at the same passage through the machine to either a square or beveled edge. Fitted with a third tool for planing the heel of the angle. Provided with friction rollers of tough steel castings with serrated faces for gripping and driving the angle bar past the fixed cutting tools. Driving is by 20-horsepower motor, furnished with reversing controller."

"Be Sure It's a Brubaker" is the title of a circular published by W. L. Brubaker & Bros., 50 Church street, New York. "There's a reason—each Brubaker lasts longer—taps more holes per tap. Staybolt taps may be similar in appearance, but when it comes to service records—well, that's where Brubaker taps are distinctive. A high-grade tap, beginning with the selection of tested steel and followed with up-to-date shop methods gained in making a better tap, insures more holes per tap by fully 20 percent. Just ask us to place a Brubaker in your shop for thirty days' trial; you will soon learn the reason why so many leading shipyards specify 'Brubaker' on their requisitions."

"The Sprague Adjustable Loop System" is the title of a bulletin published by the Sprague Electric Works, 527 West Thirty-fourth street, New York. This is a system of overhead electric freight-handling machinery for terminal sheds. The use of overhead systems in terminal sheds is advocated by Sir John A. F. Aspinwall, president of the Institution of Civil Engineers, perhaps the most conservative body of engineers in the world. Part of his inaugural address is reproduced below: "Our exports, again, cannot always be put on board ship at the moment of arrival alongside, as a vessel destined to call at many ports must have her cargo in systematic order, not only in the order of the ports, but also in relation to the character and weight of the articles exported. This means storage in transit sheds before loading, and the picking out, sorting and lifting, very often twice over, of the goods which have arrived. All these little points add to the necessity of eliminating hand labor, and doing by quick-acting machinery that which is necessary to hurry the vessel away to sea, and thus increase the number of voyages per annum. Electric overhead travelers, such as are now used in the most modern railway transit sheds, with a longitudinal traverse of 450 feet per minute, and both across traverse and lifting speed of 150 feet per minute, are probably the most suitable appliances for this work inside the sheds, while outside there should be a liberal supply of quick-acting jib cranes. At the most modern railway goods stations, where the same goods have ultimately to be handled, these quick-acting appliances, in combination with the modern electrically-propelled platform trucks, have been the cause of great economies." The Sprague adjustable loop system is pre-eminently the overhead system for terminal sheds, because it covers the whole floor area, eliminates all switches and avoids interference between the traveling hoists. Write for bulletins."

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29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS
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UNITED STATES NAVAL INSTITUTE
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INSTITUTE OF MARINE ENGINEERS, INCORPORATED
The Minories, Tower Hill, London.

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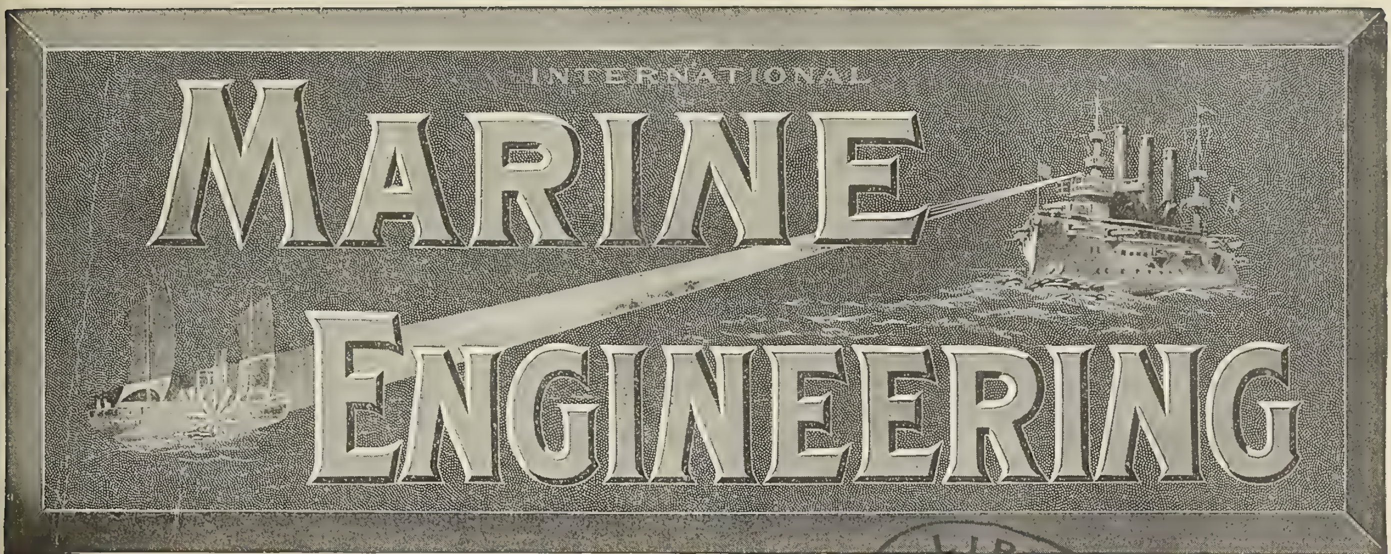

Main Office: NEW YORK 6 East 39th Street SUBSCRIPTION PRICE: Domestic, $2.00; Foreign, $3.00 LONDON OFFICE: 8 Bouverie St. E. C.

Oil-Burning Vessels on the Great Lakes

Two storage tanks of 10,000-barrel capacity, it is planned, will be built at Cleveland to provide crude oil for oil boats operated by the Emergency Fleet Corporation on the Great Lakes. About one hundred Government coal burners will be in operation on the lakes this season is the estimate of Walter M. Williams, Great Lakes assistant director of operations of the Emergency Fleet Corporation. Probably 154 Government oil-burning ships will be transferred to Atlantic service from the Great Lakes.

New York Harbor Piers Not Utilized to the Best Advantage

Large water-front areas of New York harbor, which should be available for the docking of vessels engaged in ocean commerce, are at present occupied by the various city departments.

A short review of the available piers will show how well these might be utilized. For example, the pier at the foot of East Twenty-sixth street, now used by the Public Charities, is 707 feet long by 60 feet wide, covered. The Dock Department yard, at East Twenty-fourth street, might also be utilized for the building of large piers. The entire water front from Grand street to East Thirty-first street could be used for shipping were the shell reef, over which there is about 9 feet of water, removed. At the site of the present ferry slip at the foot of Grand street another large pier could be built.

The slip beside Pier 1, the water of which is over 30 feet deep, is at present utilized for barges only. Pier 32, North River, would also be a suitable situation for a large ocean steamship pier. Other pier sites now used by the city include: East River district, from Twenty-sixth street to Twenty-ninth street, an area large enough for about six piers; eleven piers and other water-front locations occupied by the Fire Department; eight piers by the Health Department; two by the Naval Reserve, and four by the Water Supply, Gas and Electricity Departments.

At the time these various organizations were first given the use of the present sites the efficient use of every foot of deep-water front along New York harbor was probably not as essential as it is at present. The fact that these sites have in the past been used for projects which could be handled in a different manner should not deter future action regarding the reallotment of the water frontage.

Capacity of Manchester Ship Canal

The capacity of the Manchester Ship Canal, Manchester, England, as determined from the yearly report, shows that fully 3,500,000 tons were carried upon this inland waterway. The receipts show an increase of $600,000 to $700,000 over similar receipts for 1917.

Australian Government Ship Company Self-Supporting

The Austral Line of ships, bought by the Federal Government of Australia, has paid for itself during the two years of operation and realized a profit of $75,000. During the first year the line made, above expenses, nearly $5,000,000. The original cost of the ships was $9,832,500.

This satisfactory accomplishment has been cited by several authorities advocating Government management of American shipping operations.

British Vessels Available for Pacific Trade to Australia

Between the middle of January and April 1 the British Government reports that eighty-four large vessels will arrive in Australian ports. April bookings to date show that at least 700,000 tons of overseas shipping is due. Of this amount it is calculated that 500,000 tons reached Sydney harbor in March.

To Paris Via Vigo

The London *Times* reports that a new Spanish railway is projected to run from Vigo to the French frontier, as part of the American project for developing the port of Vigo, by building docks and warehouses and all the equipment of a great commercial harbor. The realization of the project would give America a commercial entrance into Europe.

Comparison of Shipbuilding Costs in the British Isles, Canada and the United States

Vice-President Powell, of the Bethlehem Shipbuilding Corporation, reports that British shipbuilding costs are considerably lower than in the United States, probably as much as $100 a ton.

Figures at hand show that in Canada labor and material costs are more than $50 a ton higher than British costs, on the basis of prices in effect before the armistice. The following table, published in the *Montreal Star*, contrasts the labor and material costs of Canadian and English companies based on an 8,100-ton boat:

	England.	Canada.	Increase Per d.w. Ton
Steel plates and shapes, per ton	$53.50	$98.28	....
2,500 tons in 8,100-ton d. w. boat	133,750	245,700	$13.80
Other hull material	114,000	195,000	10.00
Engines & boilers, labor.....	43,140	95,000	6.40
Engines & boilers, material..	98,600	160,000	7.50
Hull labor	148,700	267,660	14.70
			$52.40

Ten Dutch Vessels Will Be Returned

The Royal Netherlands Steamship Company and its subsidiary, the Royal Dutch Indian Mail, have received notification that ten of the vessels which were commandeered on March 20, 1918, by the United States Government will be returned during April.

INCORPORATIONS

The Nashville Navigation Company, Nashville, Tenn., has been incorporated for the purpose of inaugurating boat service on the Cumberland River. The following officers have been elected: H. G. Hill, president; Eugene O. Harris, vice-president; Walter H. Clarke, secretary, and Randal Curell, treasurer.

Announcement is made of the incorporation of the American Mercantile Company, Inc., at Boston and Buenos Aires, for the purpose of carrying on a general export, import and transportation business. Capital is entered as $150,000. Incorporators are Edmund H. Durgin, William H. Hodgkin and Geo. E. Kelleher, of Boston.

The Mississippi Shipping Company, a $1,000,000 corporation which has been formed to furnish steamship service from New Orleans and other Gulf ports to all world ports, is announced as a strictly New Orleans and Middle West corporation. The officers of the company are as follows: M. J. Sanders, president; T. F. Cunningham, vice-president, and Rudolph S. Hecht, of the Hibernia Bank, New Orleans, secretary-treasurer.

The Alabama Steamship Company, Mobile, Ala., has been incorporated at $625,000 to conduct a general steamship and transportation business. Jewett M. Scott, C. G. Parlin and E. G. Ricarly are the incorporators.

The Steers Terminal Company, 17 Battery Place, New York City, has been incorporated, with a capital of $50,000, to carry on a wharfage and warehouse business.

Chinese merchant men in San Francisco have subscribed $3,000,000 for the establishment of a Chinese commercial organization to aid shipping.

The Avance Navigation Company, Inc., 32 Broadway, New York City, has been incorporated, with a capital of $50,000, by Frederick H. Simmons and L. E. Brown, to carry on transportation and trade.

The Job Shipping Corporation, Wilmington, Delaware, has been incorporated, with a capital of $600,000, to engage in commerce and navigation.

The Bright Navigation Corporation has been formed, with a capital of $50,000, by Ralph J. M. Bullowa, Alex Burg and L. E. Brown, 32 Broadway, New York City, for trade and transportation purposes.

The National Steamship Lines, Ltd., New Orleans, La., has been incorporated, with a capital of $100,000, for the operation of vessels. The incorporators are Vincent Gilroy, Winter Russell, Richard Townsend, Richard Chairello, Gus G. Chairello, Vincenzo Chairello and George Kimball.

The Broad Steamship and Navigation Company, Inc., has been organized by L. E. Conklin, F. C. Harris and W. W. Shack, 24 Stone street, New York City, with a capital of $25,000, to carry on a transportation and navigation business.

BUSINESS NOTES

Charles W. Undehaun, formerly general Eastern sales manager for the Bailey-Drake Company, Chicago, Ill., has been appointed Eastern branch manager of the Black & Decker Manufacturing Company, 105 South Calvert street, Baltimore, Md.

The firm of Bloomfield & Bloomfield, 6 Beacon street, Boston, Mass., is in a position to furnish valuable information regarding industrial management. Meyer Bloomfield, one of its organizers, took charge of the Industrial Service Department of the United States Shipping Board Emergency Fleet Corporation at the invitation of General Goethals, and has recently studied industrial conditions in Great Britain.

J. F. Mackin, Columbus, Ohio, is representing the Black & Decker Manufacturing Company, 105 South Calvert street, Baltimore, Md., throughout the entire State of Ohio.

F. S. Healey has been appointed manager of sales of the Epping-Carpenter Pump Company, Pittsburgh, Pa., in addition to his office as chief engineer. F. S. Woods is now located in New York City as Eastern Sales manager; Albert A. Scheuch has been appointed assistant sales manager, and Paul D. Goodman, formerly of the McClary-Jemison Machinery Company, Birmingham, Ala., has been added to the sales personnel.

Announcement is made by the Steward Davit & Equipment Corporation, 17 Battery Place, New York, that Captain John F. Blain has resumed his prewar connection as Pacific coast agent, Coleman Building, Seattle, Wash.

F. V. Sargent has been appointed district sales manager in the Boston territory of the Cleveland Pneumatic Tool Company, Chicago, Ill. Mr. Sargent will succeed F. S. Egleston, with headquarters at 182 High street, Boston, Mass.

C. W. Johnson has been made assistant works manager of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

V. L. Sanderson, who has been in charge of the Philadelphia district of the Terry Steam Turbine Company, 605 Widener building, Philadelphia, Pa., since April, 1917, is now assisted by James H. Weir.

The Steam Motors Company, Springfield, Mass., Manufacturers of steam turbines, announces that it has appointed Raines Kessler and Louis Lanyi, transacting business under the name of the Engineering Service Sales Company, with offices at 8 West Fortieth street, as their New York representatives for the territory comprising the eastern portion of New York State, the northeastern portion of Pennsylvania, the northern half of New Jersey, and Connecticut west of the Connecticut River.

The Chicago Pneumatic Tool Company, Chicago, Ill., announces the discontinuance of its office at Wichita, Kan., and the transfer of all stock to the office at Eldorado, Kan. The company has also established offices at Tulsa, Okla., at 313 Richards building, with warehouses at 102 North Cheyenne street.

The Badenhausen Company, Philadelphia, Pa., announces the opening of a sales office by A. D. Neeld, Jr., at 311 Jenkins building, Pittsburgh, Pa., and another office under the management of J. F. O. Stratton, 1225 Marquette building, Chicago, Ill.

The Chicago branch of the General Asbestos & Rubber Company has established new offices at 14 North Franklin street, Chicago, Ill. This branch of the General Asbestos & Rubber Company, which has home offices in Charleston, S. C., will carry a complete stock of the company's products so that orders may be supplied promptly.

Theodore R. Hermanson, formerly of the Harrison works of the Worthington Machinery Corporation, has become works manager of the Epping-Carpenter Pump Company, Pittsburg, Pa.

The Wetmore Reamer Company will hereafter be known as the Wetmore Mechanical Laboratory Company, Milwaukee, Wis. This company, after completing contracts with various munition makers in Canada for the supplying of expanding reamers, hobs, taps, lathes and boring bar tools, is now resuming its former tool business. P. H. Dorr has been appointed secretary and sales manager.

TRADE PUBLICATIONS

Whitlock Rope Schedules.—A new and useful set of rope schedules has recently been issued by the Whitlock Cordage Company, 46 South street, New York City. The schedules are devoted to the company's Whitlock All-Manila Rope, and consist of two tables, which are conveniently arranged for ready reference. One table gives the sizes, both diameter and circumference; weights, in coils and per 100 feet; lengths, for full coils and feet in one pound, and strengths, both breaking strengths and working strains, the latter being figured at about 20 percent of the breaking strengths for efficiency in everyday service. In the other table is given the approximate cost per 100 feet for all sizes of Whitlock All-Manila Rope from 3/16 diameter to 8-inch circumference at basis prices from 10 to 30 cents per pound. This table is printed in black and red inks, the basis price and the item pound price of each size being printed in red ink, and the cost of 100 feet of each size given in black ink. At the foot are instructions for obtaining costs per 100 feet at prices higher and lower than those given in the tables, as well as for obtaining the cost of any number of feet. Figures in the table are calculated on the net weight of rope, and the tare is stated to average not over 1½ percent. Whitlock Rope Schedules measures 9 inches by 11 inches, is substantially bound and varnished inside to prevent soiling, and will be found extremely convenient for desk or counter use. Copies may be obtained from the Whitlock Cordage Company on request.

"How to Start Airco Torches and Equipment for Oxy-acetylene Welding and Cutting" is the title of a 34-page catalogue, illustrated in several colors, just published by the Air Reduction Company, 120 Broadway, New York. "It is intended that this book shall supply sufficient information to make it comparatively easy for an operator to quickly and correctly connect up Airco-Vulcan torches and regulators and to operate them properly. On several of the pages also will be found suggestions for the welder, which, if carefully followed, should go far toward obtaining the best results from the Airco-Vulcan apparatus. Little difficulty should be experienced in learning how to operate the Airco-Vulcan torches and equipment. In fact, when an occasional beginner fails to obtain satisfactory results at once, it is usually found that a little better understanding of the apparatus so improves its operation as to entirely remove the trouble. If every oxy-acetylene operator would become thoroughly familiar with his torches and regulators much more satisfactory work could be accomplished.

Many new tools and devices have been introduced in shops and manufacturing plants of late years, but few have proved as serviceable and successful as the Oxy-Acetylene Torch. It is to be found in active use in the shipyard, the machine shop, the foundry, the repair shop, the steel mill, on construction work, in the railroad shop, in the repair garage—its application in the engineering world is universal. A multitude of men and women workers are using it with fine success."

Westinghouse New Annual Catalogue.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued a complete catalogue in which all of its electrical supplies are listed. In compiling the catalogue every effort was exercised to make it of the greatest convenience to purchasers. The catalogue is made up of 1,264 pages of description pertaining to the products of the company, and a score of other pages contain a complete cross index, an index of style numbers, and a table of "Approximate Cost Multipliers," which enables one to figure the approximate cost of all supplies listed. Although the book is called a catalogue it contains a vast amount of information of a technical and engineering nature. Practical suggestions for the use of many kinds of apparatus for the transmission and utilization of electric power are given. It is planned to issue this catalogue annually. The publication of this catalogue is quite noteworthy, as it is the first book of such a nature published by an electrical concern having the wide diversity of products sold by the Westinghouse Company.

Benjamin Marine Lighting and Signaling Apparatus is the subject of a catalogue just published by the Benjamin Electric Manufacturing Company, Chicago, Ill. "In this catalogue are illustrated and described the Benjamin marine lighting and signaling apparatus which are in general use in the shipbuilding industry. The wide experience of Benjamin engineers in laying out and manufacturing electric lighting and signaling apparatus has been recognized by both the engineers and builders in charge of America's ship construction. In the Benjamin line all parts are standardized to the highest point in order that the utmost interchangeability may be possible. Junction boxes may be installed and the receptacles, connecting blocks, or switches, and covers may be mounted later, as the locations require. The same applies to fixtures. In them all parts are interchangeable. Such flexibility insures ease and speed of installation, convenience and protection in purchasing and absence of trouble when the ship is in service. To meet the demand for an insulation of a superior mechanical strength and insulating quality, current carrying parts of Benjamin marine fittings are mounted on bases of high heat molded insulating material. Both interchangeability and improved insulation are but one of a number of features contributing to Benjamin superiority, and are mentioned here because they are the two developments unanimously urged by shipbuilding engineers. Throughout this catalogue an individual number has been given to each item, so that long descriptions in ordering are not necessary. Each device is listed as a unit, and in addition the several parts which comprise it are listed separately. The Benjamin Electric Manufacturing Company welcomes correspondence on electrical marine devices of any character, and stand ready to assist in designing special units to meet unusual conditions."

Machinists' Supply Catalogue No. 91 has just been published by the Whitman & Barnes Manufacturing Company, Akron, Ohio. "This catalogue covers the complete list of products manufactured by us in the machinists' supply line—twist drills, reamers, wrenches and cotter pins. The maintenance of the quality of our products is the chief aim of our manufacturing organizations, continuing uninterruptedly the policies established sixty-five years ago. At our Akron, Ohio, factory we manufacture carbon and high-speed twist drills and reamers exclusively. Our Chicago factory is devoted to the manufacture of screw and drop-forged wrenches, spring cotters and special forgings. While we manufacture unrelated lines of tools, their production is the output of two separate factories, each governed by its own organization of specialists. Correspondence will be facilitated and accurate information insured if you will use the list numbers, terms and descriptions accompanying the lists, both in the headings and foot notes. When referring to special tools or forgings give a concise description and send sample or sketch showing dimensions with your specifications. We invite your inquiries, specifications and orders, assuring you of our appreciation of any opportunity to quote prices and give information pertaining to our lines."

The De Laval Method of Purifying and Reclaiming Oils is the subject of Bulletin No. 103, published by the De Laval Separator Company, 165 Broadway, New York. "It tells a remarkable story of how the De Laval centrifugal oil purifier saves oil and insures longer of marine engines. Shipbuilders, shipowners, designers, chief engineers and others interested in these vital problems are invited to send for the bulletin—no obligation is incurred."

Bituco Solution and Enamels are described in a circular published by the Bituco Manufacturing & Chemical Company, Inc., 422 Commercial Trust building, Philadelphia, Pa. "Bituco solution and enamels are especially adaptable to the preserving of coal bunkers, tank tops, peaks, inner bottoms or ballast tanks, fresh water tanks, wing tanks, bilges, chain lockers, engine and boiler seatings and foundations, etc. Bituco dries quickly with a hard enamel finish, and will not flake or crack. Bituco solution and enamel are the products of natural bitumens. They carry all the elements needed to protect iron and steel from corrosion, and should not be confounded with materials of similar appearance containing asphaltum or petroleum residues. Bituco products are not soluble in gasoline."

WRITE FOR SAMPLE

The Carwen Static-Dynamic Balancing Machine is the subject of a circular published by the Carlson-Wenstrom Company, Erie avenue at Richmond street, Philadelphia, Pa. "With the rapid adoption of turbine-driven machinery, and the increased speed at which it is to-day considered safe to run almost all classes of machines, the necessity of eliminating vibration becomes more and more important. With the general increase in speed, not only is there more stress, but the tendency towards vibration has become much greater, and consequently the damaging effects resulting have grown in proportion. The greater the speed at which a machine is run the less will be the amount of out-of-balance necessary to cause vibration, and the more intense the vibration the greater will be the tendency towards loosening of parts, opening of bearings, springing of foundation, etc. Therefore, it becomes a matter of great importance that machine parts that travel at a high rate of speed should operate without excessive vibration. No matter how carefully an electric armature, automobile crankshaft, turbine rotor, centrifugal blower, in fact any machine traveling at high rate of speed, be made, it is practically an impossibility for it to leave the mechanic's hands in true balance. Through the efforts of our engineers we are able to place on the market the latest type of the Carwen-Static-Dynamic Balancing Machine. With this latest creation it is possible to determine within a few moments the exact plane of unbalance, together with exact amount of unbalance, by simply applying the readings of the machine to chart furnished, showing exactly the amount of metal to be added or removed, and at what points to produce a perfect running balance. The production obtained depends upon the size and weight of the object to be balanced. On small pieces it is very great. The entire process, for instance, of setting up an object weighing approximately 125 pounds, measuring the unbalance and reading chart takes less than five minutes in a Carwen machine, and the result is better than that heretofore obtained with hours, sometimes days, of careful trial by the hit-and-miss method, and there is absolutely no guesswork about the reading."

Hanna Riveters are described and illustrated in a catalogue published by the Vulcan Engineering Sales Company, 1755 Elston avenue, Chicago, Ill. "Is the portable riveter you are going to buy designed with an eye toward the convenience of the operator, or is it so cumbersome as to hamper and hinder his movements? Hanna riveters are made in many types and sizes, but in all of them the same fundamental principles have been retained. They are the result of careful study of actual operating conditions. Used in practically all shipbuilding plants throughout the country. Write for catalogue, which illustrates and describes these machines."

"Useful Knots and How to Tie Them." Anyone who wishes to learn how to tie knots of all kinds should write to the Plymouth Cordage Company, North Plymouth, Mass., and ask for a copy of their illustrated booklet "Useful Knots and How to Tie Them." It will be sent free to any of our readers upon request.

Tests of the Badenhausen preheater type boiler are the subject of Bulletin No. 101, which has just been published by the Badenhausen Company, 1425 Chestnut street, Philadelphia, Pa. This bulletin gives full details of tests of the Badenhausen boiler installed at the Ford Motor Company's Detroit plant. The Badenhausen Company will be glad to send copies to anyone upon request.

Air Compressors are described in Bulletin No. 3230, just issued by the Ingersoll-Rand Company, 11 Broadway, New York. "There's a little something that enters into the building of an Ingersoll-Rand class 'ER' or 'FR' compressor that makes these small units stand out as superior in the test of racking, constant service. It gives them a distinctive place in the field of small machines, make them the first choice when it comes to the selection of an air compressor to fill a place of responsibility. Not only reliable, but also economical. Efficient design minimizes the power requirement and automatic features keep down the need of attendance. When you need a good, small air compressor investigate the Ingersoll-Rand machines."

HELP AND SITUATION AND FOR SALE

☞ *No advertisement accepted unless cash accompanies the order.*

Advertisements will be inserted under this heading at the rate of 4 cents per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent per word. But no advertisement will be inserted for less than 75 cents. Replies can be sent to our care if desired, and they will be forwarded without additional charge.

For Sale—Two new 240-horse-power Skandia Pacific oil engines, with air compressor and shafting complete for auxiliary schooner installation. *Wallace R. Foster,* 100 Broadway, New York City.

Wanted—Position as Purchasing Agent; sixteen years' experience—eight years railroad, eight years shipbuilding. New construction and reconstruction work. First-class references. Address *Purchasing Agent,* care of Marine Engineering.

Marine Engineer and Draftsman, technical graduate with over eleven years' experience in shipbuilding, of which seven years with American yards, desires responsible position here or abroad. Speak Italian and Spanish. Address *Box 7,* care of Marine Engineering.

Hull Draftsman—Nine years' experience, construction and detail, both naval and merchant vessels, desires position around New York. Present employed. Address *Hull Draftsman,* care of Marine Engineering.

Position Wanted as Marine Superintendent engineer, representing American shipping interests in Southern British ports. Thoroughly acquainted with places and methods of working. Energetic and trustworthy. Address *Superintendent,* care of Postoffice, Newport News, Va.

Shipbuilder—Open for suitable responsible position; last employed as Superintendent of hull construction; capable man in drafting office. Over 20 years' varied experience, principally on small and light draft river work. Address *Box* 779, care of Marine Engineering.

Marine Refrigeration—All-around Engineer, Practical and Technical, with many years' experience, marine (and land), with leading British firms, CO_2 and NH_3 systems, and all classes of cargo and provision carrying, who have ORIGINATED CO_2 refrigeration with British firm, desires post with American engineers to commence refrigeration in new shipbuilding. Can carry job through, *i. e.,* estimation, design (on blank sheet, not copy), manufacture, erection, running, etc. Address *Marine Refrigeration,* care of International Marine Engineering, 8 Bouverie street, London, E. C. 4.

Salesman Wanted—A large corporation has an opening for a high-grade oil salesman with a large acquaintance among the maritime trade, shipowners, chief engineers, etc., at the principal North Atlantic ports. Apply by letter, stating qualifications, to *Box* 97, care of Marine Engineering.

For Sale—One Wheeler Admiralty type Surface Condenser, 1,080 square feet cooling surface, and complete with 12 x 14 x 14 x 14 combined air and circulating pump. Condenser is in good operating condition and being displaced by larger unit. For further particulars address *Texas Star Flour Mills,* Galveston, Tex.

Two Production Engineers, capable and experienced in handling material from mill to hull by economical, efficient system, desire connection in East or South. Highest recommendations from present associates. *Box* 8, care of Marine Engineering.

Marine Oil Engines—Designer of large marine oil engines of the heavy duty type, decidedly successful with his engines; good organizer, at present department head of large oil engine company, wishes contract with shipyard. Address *Oil Engines,* care of Marine Engineering.

Marine Manager or Superintendent of Construction. Fifteen years' broad, practical experience, at present holding important Government position in shipbuilding. Will consider worth-while proposition as above or will represent shipyard or manufacturer in New Work. Address *Box* 805, City Hall Station, New York.

Consider this Advertisement if you wish a high-grade man. At age of 14 entered three years' apprenticeship in shipbuilding and attending Evening Technical School during that time; at age of 17 entered woodworking shop as machine hand; cabinetmaker and foreman for three years. Spent one year in Technical School; graduated, received diploma; then one year on mechanical work, another year in Technical College; graduated, received second diploma. Two years as Mechanical Draftsman, three years on designing and production engineering; for past two years on Emergency Fleet work as leading draftsman on joiner work. Continuation of evening schools, keeping in touch with the latest and best books and trade publications, have given me a broad knowledge of modern production methods. A young man of energy, knowledge and ambition, now in his thirty-first year, desires to make permanent connection with shipyard or industrial organization in executive position, preferably combination of steel and woodworking in planning department or on production work. Address *Production,* care of Marine Engineering.

Foreman Loftsman wanted by a shipyard in the North Atlantic District building steel vessels for the United States Shipping Board. Only an experienced competent man required. In writing, please state fully experience, training, and give reference, together with salary expected, addressing letters to *Box* 456, care of Marine Engineering.

Sturtevant Steam Engines are described in a special catalogue, No. 239, just published by the B. F. Sturtevant Company, Hyde Park, Mass. "Sturtevant steam engines are now made in two types only—VS-7 and VS-8 (vertical, single cylinder). All others have been eliminated to enable us to meet the demand for these two types. The difference between these two is one of lubrication—VS-7 is forced feed—both systems have their friends. These engines were designed to fulfill the United States Navy specifications, which means that they must have the utmost reliability under all conditions of service. Our engine department was 100 percent engaged in Government work, and we are proud of the fact that our standard engines were accepted without a single alteration. These engines are both used for direct connection to blowers, fans, generators and for independent power service, automatic and throttling."

Small Tools are described in Cleveland Hand Book No. 6, just issued by the Cleveland Punch & Shear Works Company, Cleveland, Ohio. "In each successive step in the manufacture of Cleveland small tools—from the selection of the material until the finished product leaves the workshop—great care is exercised to see that every tool 'measures up' to the same high standard which has during the past twenty-five years made an enviable reputation for Clevelands as the dependable small tools. Cleveland small tools are 'made good to make good'; therefore, when you specify Clevelands you are specifying small tools that are guaranteed to give a maximum of service."

Kitchen's Patent Reversing Rudders are described in an illustrated catalogue published by Mr. Gordon H. Fraser, 747 Royal Liver building, Liverpool. "These reversing rudders give direct and instantaneous control of the ship from the bridge without reference to the engine room. For running long distances at anything less than full speed an engine room telegraph will, of course, still be required, but it will not be necessary to use it for maneuvering purposes in confined waters or in docks and harbors. The increased power to maneuver given by the reversing rudders will enable many ships now dependent on tugs to dispense with their services. Fitted to tugs the rudders will be especially useful. It should be noted that the rudders enable a ship to be controlled in a current or a tide race equally as well as in still water. They give a ship steerage way when going slower than the current but in the same direction."

The Camden Iron Works, Camden, N. J., engineers, iron founders and machinists, has just issued a catalogue describing the following: "Cast iron pipe, flanged pipe, castings up to 130,000 pounds, made and machined; cast iron rams up to 35 feet long. Hydraulic tools for boiler and plate shops, punches, shears, riveters, accumulators, pumps, flanging presses, forging presses, hydraulic cranes, keel benders, plate benders, angle benders, manhole punches. Centrifugal pumps, single and multiple stage, for clear water, drainage, sewage, chemicals; pumps with horizontal shafts and with vertical shafts, non-corrosive impellers; circulating pumps; direct-acting steam pumps for high pressures."

Staybolt Taps are described by the Pratt & Whitney Company, 111 Broadway, New York, in a circular just published. "Like all P & W small tools, Pratt & Whitney staybolt taps are liked for their nice working qualities and their exceptionally long life of service. They're not only good when new, but are heat treated and seasoned to maintain this goodness. Because they cut threads accurately and cleanly with the least expenditure of time and effort, these better taps are favorites in the shop. If you've used them before you know just how good they are. If you haven't, send us your first order—we know you'll be back for more. They're carried in stock in our sales rooms in all large cities as listed here."

Dependable Deck Machinery is described by the American Clay Machinery Company, Bucyrus, Ohio, in a catalogue recently published. "This is a dependable line of deck machinery, especially designed to meet exacting Government requirements and built to pass rigid Government inspection. This line is 'Built Right and Runs Right.' So satisfactory was it in design and construction that the largest sales ever made of this class of equipment were sold for Government ships. Each machine is built in quantities on the interchangeable parts plan, and prompt shipments are possible. The line includes winches, capstans, steering engines, windlasses, etc. We solicit correspondence and will be pleased to refer to users of our line."

The Wager Furnace Bridge Wall is described in Booklet M, just issued by the Wager Furnace Bridge Wall Company, Inc., 149 Broadway, New York. "The Wager furnace bridge wall has proved its value in actual use under all conditions. It has been giving economical service for years without repairs in the fleets of many of the steamship and railroad companies, as well as scores of ships for the United States Government. Equally serviceable for marine or stationary boilers using either hard or soft coal. Send for Booklet M, containing information of vital interest concerning boiler efficiency, together with a list of installations, which is in itself the strongest kind of endorsement of the Wager furnace bridge wall."

The Fire-Gun is described and illustrated in a bulletin published by the Fire-Gun Manufacturing Company, 115 Fourth avenue, New York. "The Fire-Gun puts out little fires before they get to be big ones. Fire-Gun is a new liquid pump which is positively double acting from the first stroke until it is absolutely empty. Never pumps air; never suptters or drips, but shoots a solid stream 30 to 40 feet; will stand roughest usage; never leaks nor fails to operate; Fire-Gun holds 25 percent more fluid than other hand extinguishers, and this extra fluid often saves the day. Fire-Gun fluid is effective where water is useless; it will not deteriorate; it is a non-conductor of electricity; does not freeze at 50 degrees below zero, and will not damage machinery or delicate fabrics."

Vulcan Drop-Forged Chain Pipe Vises are described by J. H. Williams & Company, 63 Richards street, Brooklyn, N, Y., in a booklet just published. "These vises are unbreakable, compact, rapid in action and positive in gripping pipe. They are attachable anywhere—any handy bench, post or other support will serve. They are made entirely of wrought steel, the drop-forged jaws are saw-tempered for file sharpening, and the hand-made chains are of the same superior quality as those of our well-known "Vulcan' and 'Agrippa' chain pipe wrenches. Adjustment is quickly effected by engaging the projecting rivets of the chain with a series of stepped bosses on the base, when the pipe may be instantly locked in an unbreakable grip by a turn of the handle. Vises in three sizes for 1/8- to 8-inch pipe. Remember, Williams' chain pipe tools have been standard for nearly half a century—they are all backed by our absolute and unconditional guarantee of service."

Boyer Pneumatic Hammers are described by the Chicago Pneumatic Tool Company, Fisher building, Chicago, Ill., in Bulletin 124. Little Giant ball-bearing drills are described in Bulletin No. 127, and Chicago pneumatic compressors are described in Bulletins 34-N and 34-M. We quote as follows: "Boyer pneumatic hammers—standard the world over wherever pneumatic hammers are used. Workmen like the 'Boyer' because it helps them to do more and earn more. Boyer hammers are made for riveting, chipping, calking, scaling, etc. Little Giant ball-bearing drills—in work accomplished, economy of air and durability—Little Giant drills have consistently proved themselves the best among portable air drills. Made in a wide variety of styles and capacities, both reversible and non-reversible types. Chicago pneumatic compressors, built for better service—they give it. A complete line, embracing over 300 distinct sizes and types, assures the right compressors for any service requirement. Prompt deliveries are again possible.

MARINE SOCIETIES

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS
Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS
29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS
29 West 39th Street, New York City.

UNITED STATES NAVAL INSTITUTE
Naval Academy, Annapolis, Md.

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National Treasurer—Albert L. Jones, 38 Avery Avenue, Detroit, Mich.

CANADA

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Grand Secretary-Treasurer—Neil J. Morrison, P. O. Box 886, St. John, N. B.
Grand Conductor—J. W. McLeod, Owen Sound, Ont.

GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND
39 Elmbank Crescent, Glasgow.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORPORATED
The Minories, Tower Hill, London.

INTERNATIONAL

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Linde Oxygen is a Vital Element in this Supremacy
Linde Oxygen is distributed from 65 stations, located for serving all users according to their needs—1000 cylinders, or 1, as the case may be. The Linde Organization is so big, any customer's sudden increase or shrinkage in oxygen consumption is instantly absorbed as a mere incident in the day's work.
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THIS CYLINDER CONTAINS
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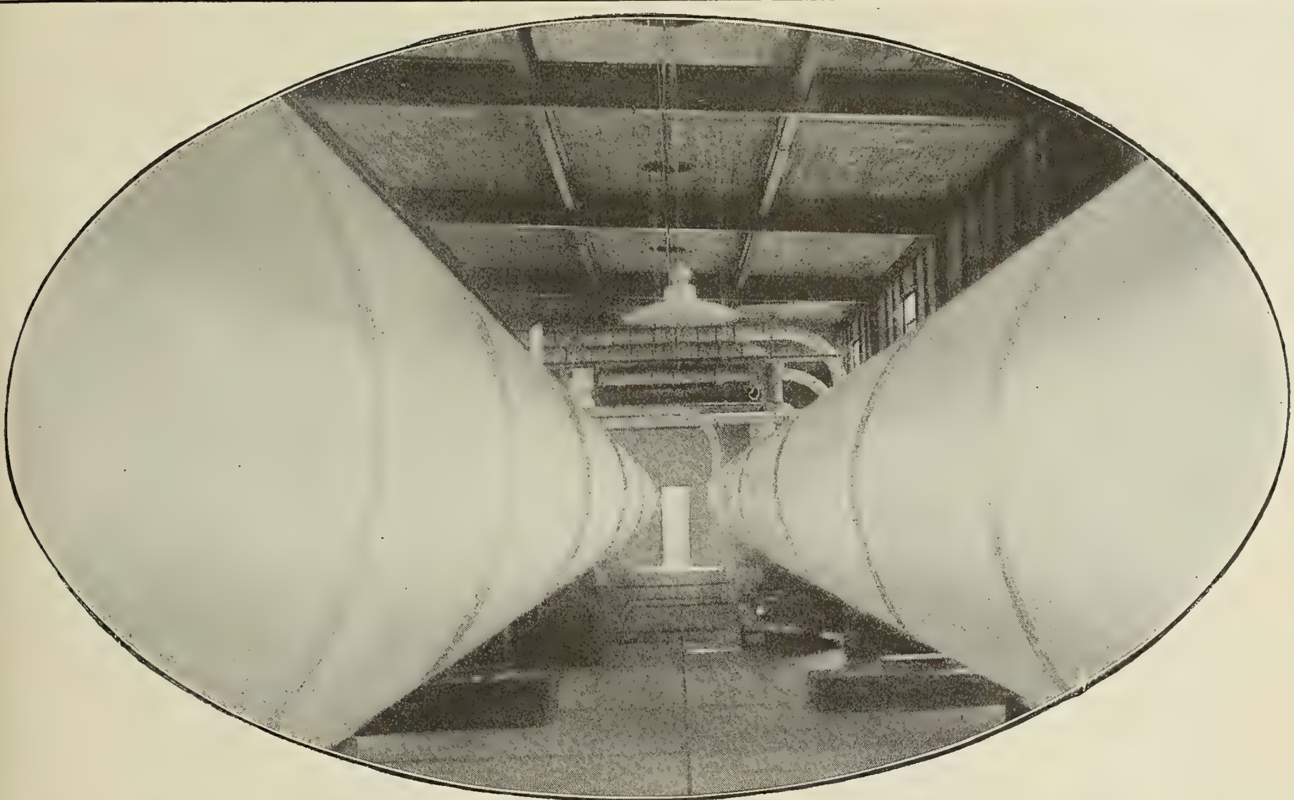
Kohl Building
San Francisco



This Big Creosoting Plant is Covered with "85% Magnesia"

THE admitted supremacy of "85% Magnesia" for the covering of steam pipes and boilers has led to its adoption for many other fuel-saving purposes. The illustration shows the large pole *creosoting* plant of the L. & N. R. R. Co., at Gautier, Miss.

The tanks are 135 feet long by 7 feet diameter and the poles are pushed on trucks right into the tanks which are then hermetically closed. Steam is forced in to season the wood. This is followed by hot creosote oil.

The treatment lasts for several hours, during which time the necessary temperature is maintained by the "85% Magnesia" coverings, resulting in a large saving of coal over the old way, whereby it was necessary to heat the Creosote continuously during the entire operation.

In addition to the tanks themselves, the steam boilers, pipes, valves, flanges and fittings are all covered with "85% Magnesia."

This is only one of the many fields wherein "85% Magnesia" is daily demonstrating its efficiency as a heat-saver, not only in chemical but in manufacturing plants of all kinds. For covering pipes, stills, receivers and all carriers or containers of heat, *"85% Magnesia" stands alone for maximum heat-saving efficiency, durability, and in actual cash-per-year return on the investment.*

ASK FOR THE PROOFS

For two years the Mellon Institute of Industrial Research has conducted experiments to prove the definite degree of its efficiency under varying conditions of temperature and pressure. A Table of the Monthly Coal Savings in Dollars and Cents by use of "85% Magnesia" has been prepared by this Institute, and the Magnesia Association will mail it to you for the asking. Also the illuminating booklet, "Let '85% Magnesia' Defend Your Steam. If you are an engineer or architect, ask us for the Specification for the scientific application of "85% Magnesia," compiled and endorsed by the above Institute.

MAGNESIA ASSOCIATION *of* AMERICA
Bulletin Building, Philadelphia, Pa.

EXECUTIVE COMMITTEE, Wm. A. Macan, *Chairman*
George D. Crabbs, The Philip Carey Co. Cinncinati, Ohio
J. R. Swift, The Franklin Mfg. Co. Franklin, Pa.
Alvin M. Ehret, Ehret Magnesia Mfg. Co. Valley Forge, Pa.
R. V. Mattison, Jr., Keasbey & Mattison Co. Ambler, Pa.

TRADE PUBLICATIONS

The Atlas Soot Blower is the subject of a circular issued by Albert Otto & Sons, Inc., 101 Park avenue, New York. "Many devices have been invented to overcome the soot, but all were lacking in efficiency, due to faults in construction and method of operation until the advent of the Atlas soot blower, which embodies the following points of efficiency: 1, it cleans in the logical direction, viz., with the draught and not against, thereby blowing the soot up the stack and not back on the rear plates; 2, it is operated from the front, always under the eye of the engineer; 3, it reaches every part to be cleaned with dry steam, and does the work thoroughly; 4, there is no obstruction on the smokebox floor, the handle being in position only when the blower is in use; 5, it may be quickly, easily and economically installed, even when boiler is under full pressure; 6, its saving in coal and increase in speed of vessel has proven on official tests to amount to 10 percent and over. An Atlas soot blower is absolutely essential where superheaters are used. Without one the tubes get sooted up immediately and the superheater is practically useless. Thousands of Atlas blowers (under the English trade name) are now doing efficient service in the British Admiralty and mercantile marine, conserving coal, increasing heating surface efficiency and actual speed of ships. Naval authorities pronounce the Atlas the most efficient appliance of its kind yet devised. The British Admiralty is now using it to the exclusion of all other makes, and are taking practically the entire output of the English manufacturers."

The Standard Cutting Torch, Style C. made by the General Welding & Equipment Company, 107 Massachusetts avenue, Boston, Mass., is described in a circular just published. "The construction of a first-class tool should combine two essentials: First, efficient and economical work; second, easiness of repairs and maintenance, so that the operator can do everything himself, making him independent of the manufacturer. Both essentials are covered with our cutting torches. First, they are used by the thousands and by the most prominent concerns, which proves their efficiency; second, all essential parts are easily accessible and exchangeable, and by carrying a few spare parts even a smashed cutter can be fixed up like new in less than one-half hour by your own man. Many concerns standardized on our cutters impressed by their marvelous and simple construction."

Terry Cargo Cranes are described in Bulletin 3, published by Edward F. Terry Manufacturing Company, Grand Central Terminal, New York. "We have a large and varied experience in the design and manufacture of hoists and cranes, and will gladly assist prospective customers in the study of their requirements and in the preparation of plans for wharf development and freight-handling equipment. And we would call attention to a fact frequently overlooked, that in order to obtain complete co-ordination of cargo-handling operations, together with minimum cost of handling and best use of storage space, it is necessary that the proper type of handling equipment be selected at the very beginning, and that the wharf or pier and its shed should be designed to provide for such equipment."

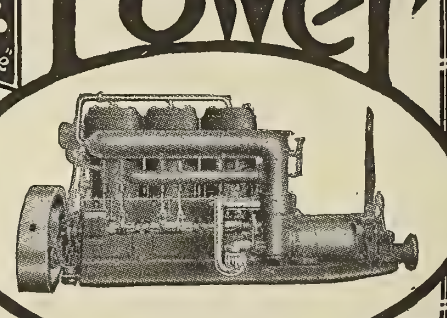
Castings, Shipfittings, Forgings, made by the American Standard Shipfittings Corporation, 115 Broadway, New York, are described in a bulletin the company has just issued.

The Steam Motor manufactured by the Steam Motors Company, Springfield, Mass., is described in Bulletin No. 5 just issued. "The outstanding feature of the steam motor is that it is not a complete turbine in itself, but when connected to its driven member becomes an integral part of the complete unit, making possible the ideal compact two-bearing unit with any standard design of driven apparatus. There are no new or experimental features introduced in the design, but the arrangement of the machine as a whole is a rational and logical departure from the accepted turbine practice; the effect of which is to eliminate the inherent weaknesses of the three or four bearing design while maintaining all the advantages of the turbine drive."

"The Emergency Rope" is the title of an article published in the May issue of *Plymouth Products,* issued by the Plymouth Cordage Company, North Plymouth, Mass. "A structural iron worker writes: 'In the winter of 1919 I had the contract to erect a girder bridge over the Lehigh Valley Railroad tracks a few miles below Pittston, Pa. The girders weighed over 18 tons each. We rigged up with triple blocks, bought a new 1½-inch manila rope and made ready to erect on a Sunday morning with a gang of eight men, paying each one dollar an hour, or double time. Just imagine how I felt when I saw my new line part without budging one end from the railroad tracks. Of course, all of my work on that day and the day previous went for naught and added a considerable item of expense to the job and put me on the losing end. I bought another 500 feet of 1½-inch manila rope made by the Plymouth Cordage Company, and rigged up again for the following Sunday and erected my job without any further trouble. For some reason the county engineer would not permit me to set the anchor bolts, and as the weather was very cold about that time it caused considerable contraction of the steel. Consequently, when I came on the job one morning I found the bridge had shifted about 1 inch out of center, and was at a loss to get it back, as I had only one jack and very little blocking. I had the floor system all in and bolted up solid, which made the job somewhat heavy to handle, it weighing, complete, about 55 tons. The only thing I could do was to take a chance on picking one end up with the gin pole, which was still in place, so I hooked onto the end floor beam and went ahead with five turns on each of the two niggerheads and jacked it over to center. While the juice fairly ran out of the rope, it held, and I used it for many a day thereafter. Ever since then I have made it a practice to use Plymouth rope, as I found it very unprofitable to erect steel twice for one price.'"

"Monel Metal," which is stated to be a natural combination of nickel and copper, and which can hardly be distinguished from pure nickel in color, is described by the Bayonne Casting Company, Bayonne, N. J., in a 48-page booklet just issued. "It is truly said that industry never creates a demand that the engineer or metallurgist does not meet. Copper and bronze alloys served most purposes satisfactorily so long as they were only required to withstand alkaline or acid solutions. With the growth of industry new conditions have arisen which call for metals possessing unusual qualities. There is a broad field for an alloy which will withstand acids, high temperatures and the erosive action of hot gases and superheated steam. Monel Metal, highly non-corrodible and with the strength of steel, meets these severe requirements. Monel Metal was first made ten years ago, and the demand for it has grown as rapidly as the knowledge of its characteristics could be spread. In the early stages of development, Monel Metal was supplied only for its high tensile strength and relative immunity to corrosion, while at the present time Monel Metal has many diversified uses. It is the endeavor of the Bayonne Casting Company in issuing this pamphlet to direct attention to the physical properties of Monel Metal, the forms in which it is sold and its general uses. It is our further purpose to cooperate in every way with the users of Monel Metal in order to insure its satisfactory application and service. Some of the methods of treatment are not very generally understood, and it is our desire that any consumer wishing technical advice or information will communicate with us."

Seamless Steel Boiler Tubes, arch tubes, superheater flues and pipes are described in a circular published by the Pittsburgh Steel Products Company, Pittsburgh, Pa. According to the circular, "this company's products are made exclusively of the highest quality basic open-hearth steel of special formula, very low in sulphur and phosphorus, and resist corrosion and pitting, are true to size and gage, fit perfectly in the flue sheet and decrease the cost of installation; they have no weld, have greater tensile strength and elastic limit, a greater factor of safety, and increase the efficiency of boiler service. They are the cheapest in the end."



Brass Goods and Iron Specialties are described in a profusely illustrated cloth-bound catalogue of 470 pages which has just been published by the Kelly & Jones Company, Greensburg, Pa. This catalogue is an invaluable one, and should be in the hands of all users of brass and iron goods and specialties for steam, gas, water, air and oil. "Having been engaged for many years prior to the beginning of our career as manufacturers in the erection of steam power and heating plants, as well as plumbing and hydraulic work, we acquired a knowledge of the wants of the trade, which has been of inestimable value to us in designing and manufacturing the line of goods which we illustrate in this catalogue. Our extensive factories, which we are enlarging from time to time, as the growth of our trade demands, are located in the center of the great iron- and fuel-producing section of the United States, with superb facilities for shipping goods to all parts of the world, and equipped with the very latest and best automatic machinery, much of which has been designed by us for various special purposes. In every department of our works—from foundries to finishing shops—we employ none but the most skillful workmen, who are directed by capable superintendents in each department. All our work is subjected to the most thorough inspection and test during the process of manufacture and after completion. We are thus fitted for the economical manufacture of goods of a quality unexcelled in the world. To this we attribute the remarkable growth of our business; and it is our highest ambition to continue to deserve the patronage of the trade by not only maintaining the high standard of our work, but, wherever possible, to make improvements; and we will, from time to time, add to our line such articles as may be demanded by the continued development of engineering science."

Modern Gratings for Ships are the subject of Catalogue 2A-10, issued by the Irving Iron Works Company, Long Island City, N. Y. "The modern grating flooring for the modern ship. Apply to Irving subway any measure of merit you will, and you'll find in it everything that is desirable from a standpoint of up-to-date marine efficiency. Is it lightness and strength you seek? Irving subway is the lightest, strongest metallic flooring made—has the largest load capacity per unit of weight and span, and therefore saves on dead loads by needing only lighter supports. Is it a question of safety? Irving subway is fireproof and absolutely non-slipping. Even oil or grease or soap—even snow or ice—cannot destroy its foot-gripping surface. Is ventilation and lighting sought? Irving subway gives 80 percent opening for the passage of light and air—yet the individual openings are so small that only the smallest objects can pass through. Is a comfortable, efficient working surface wanted? Men can push or haul heavy loads over Irving subway without slipping. Wheeled trucks and rib-hooped barrels roll over it easily. And for ladders, there's the Irving safety ladder step—a small panel of Irving subway—light, strong, elastic, non-slipping, non-dirt collecting—the ideal marine ladder step."

Bradley Hammers for shipbuilders are described by C. C. Bradley & Son, Inc., Syracuse, N. Y., in a catalogue just published. "Did you ever stop to think that with a Bradley Hammer, a good man and proper dies you could make all your own punches and chisels right off the bar in your own plant and at the minimum of expense? Surest thing you know. These illustrations were taken from photographs of the actual articles thus made. The smaller punches can be made at the rate of probably 100 per hour and the larger ones at the rate of 80 per hour, and to 0.010 inch perfect at that. More accuracy, less quantity. A 'hammered' punch will beat a turned punch to death. The 'waste' of stock is practically confined to short bar ends, as the excess of metal from one punch goes into the next punch. You will have no 'turnings' for the scrap heap. Just cut off the punches under the hammer, grind cutting edge and temper. Simple, isn't it? Cold chisels, both hand, and for pneumatic hammers made under the Bradley at the rate of 80 per hour. Just cut off, grind cutting edge and temper. Bradley hammers are rarely idle unless you have less work than they can do."

"Armo Iron Rods and Wire for Oxy-Acetylene and Electric Welding" is the title of a 64-page booklet published by the Page Steel & Wire Company, 50 Church street, New York. "Suitable filling material is one of the most important factors in making successful welds. Many failures in welding are directly traceable to the use of material that cannot produce a weld with mechanical properties similar to those of the metal. A skilled operator can correct an improper flame or arc—he can, if necessary, readjust, reshape or reclean the surfaces to be welded, but he cannot alter the composition of filler rods. If the filling material is unsuitable, it cannot be expected to flow evenly or to produce welds that are free from pinholes, soft, hard or brittle spots, etc., even if applied by the best welder. The first essential of welding material is purity; that is, freedom from such foreign matter as sulphur, phosphorus, manganese, silicon, slag and oxides. In the welding of mild steel and wrought iron the mechanical property of elongation is lowered in the line of the weld. It is therefore necessary, in order to increase the holding power of the joint and the elongation of welds in steel or iron, to employ as a welding rod an iron that is even purer and more sound than the metal of the parts to be joined. In the past, experienced and conscientious welders have employed Swedish and Norway iron made with wood charcoal, but since the world war the importation of welding material from the Scandinavian countries has been impossible. Following the example of other industries, the American Rolling Mill Company and the Page Steel & Wire Company undertook the development of suitable American-made welding rods. Together at the furnace, at the microscope, in actual applications and in ways never attempted before, the metallurgists and laboratory specialists of these organizations have developed a welding material that has now demonstrated even better results in toughness, density, homogeneity and freedom from segregated impurities and occluded gases than had previously been obtained from the foreign product."

The Ford Tribloc is described by the Ford Chain Block & Manufacturing Company, Second and Diamond streets, Philadelphia, Pa., in a catalogue just published. "Its strength is surprising. The all-steel working parts mean that you can depend on it, too. It has a safety factor of 3½ to 1 in its weakest part—no greater is found in any hand-chain hoist. And just because those working parts are steel instead of the ordinary cast iron, a Tribloc is not only stronger and safer but also wears longer. The safety is further increased by our patented loop hand-chain guide—which prevents the 'gagging' of the hand chain at any speed or any angle. Nothing that could add to the efficiency or safety of a Tribloc has been overlooked. It's so good we guarantee it for five years."

Williams "Vulcan" drop-forged chain pipe vises are described in a booklet issued by J. H. Williams & Company, 63 Richard street, Brooklyn, N. Y. "These vises are unbreakable, compact, rapid in action and positive in gripping pipe. They are attachable anywhere—any handy bench, post or other support will serve. They are made entirely of wrought steel, the drop-forged jaws are saw-tempered for file sharpening, and the hand-made chains are of the same superior quality as those of our well-known 'Vulcan' chain pipe wrenches. Vises in three sizes for ⅛- to 8-inch pipe. Remember, Williams' chain pipe tools have been standard for nearly half a century—they are all backed by our absolute and unconditional guarantee of service."

Bolinders Oil Engines are described and illustrated by Bolinders Company 30 Church street, New York, in a circular recently published. "Bolinders engines make ideal power plants for oil barges and tankers. Their compactness, light weight, extreme dependability make them by far the most efficient propulsive power for boats of this type. What Bolinders engines have done and are doing for the Standard Oil Company they can do for you. The following Standard Oil Company's boats are Bolinders Equipt: *Starlite, Moonlite, Twilite, Dawnlite, Sunlite, Daylite, La Merced, Oronite, Socony No. 62, Socony No. 5, Socony No. 6.*"

A Semi-Centennial Souvenir—1868-1918, has just been published by the Yale & Towne Manufacturing Company, 9 East Fortieth street, New York, in the belief that a biography of modern industry will make interesting reading. "Biography constitutes a large part of the world's literature. It is the record of individual lives. History is collective biography—the record of the lives of nations. This booklet outlines the biography of a modern industry. The origins of primeval industries, or man's crude beginnings in the useful arts, have long been the subject of research, study and record. Is it not desirable that record should now be made of the fruition of man's achievements in this field, as illustrated by the origin and growth of modern industrial plants and organizations? In the belief that this question should be answered affirmatively, this brief record has been compiled. The time seems fitting, because it marks the semi-centennial anniversary of the founding of the industry described, and because one of its founders is still available as a source of information."

The Pease Peerless Blue Printing Equipment—"three machines in one" —is described by the C. F. Pease Company, 230 Institute Place, Chicago, Ill., in Catalogue B. "Can be installed in one end of drafting room, constantly under supervision of chief draftsman. Occupies only 5½ by 6½ feet of floor space. No open wash trays; no wet floors; no lines of dripping prints; no waste of sensitized paper; no noisy and unreliable friction discs; all speeds electrically controlled; exposed paper is thoroughly washed, evenly dried, and delivered free from distortion or wrinkles; printer may be used independently from washer and drier if desired. Maximum output, one operator, 100 linear yards per hour, consuming only 7 kilowatts electric energy and 50 cubic feet of gas. Electricity instead of gas may be used for drying if desired."

Dock Cranes installed in a French port by the Brown Hoisting Machinery Company, Cleveland, Ohio, are described and illustrated in Catalogue K, which the company has just published. "If the United States docks were only equipped similar to this shipping would be speeded up. The incoming cargo could be unloaded and the ship receive its export freight in a day or two instead of taking up dock space for a week or more and holding up other vessels. An idle ship is wasted shipping, and requires just that many more ships to carry the goods. It would greatly reduce the number of dock hands, and help remedy this serious problem. It would eliminate practically all the hard work for the men, and this would mean better satisfied workmen. And it would reduce the cost of handling, because the Brownhoist cranes handle the cargo rapidly and with a less number of men."

Pipe Replacement Costs are treated upon in a circular published by A. M. Byers Company, Pittsburgh, Pa. "In every old established industry the trend is strongly towards Byers genuine wrought iron pipe. The reason is simply that years of experience with pipe failures and replacements have brought home a forceful lesson in the high cost of cheap pipe, and the ultimate low cost of Byers pipe. It is only in the new installations (where this lesson is still absent) that the rust-resistance and economy of Byers pipe is not at once apparent."

Kelly Boiler Fronts are described in Catalogue G, published by the Kelly Foundry & Machine Company, 623 Ninth street, Goshen, Ind. "Design, style and sizes of the Kelly boiler fronts and trimmings have been established for years and conform to the average power plant. Many patterns have accumulated and special work can be furnished on short notice. Pattern and machine shops are well equipped to handle work from blue print or sketch. Complete setting consists of front proper, fitted with flue, fire and ash doors, baffle plates fitted to fire doors, dead plates and liners, rear grate rest and grates, rear arch rest and arch bars, back-stays and diamond washers, soot door and frame, breeching frame and damper. Front accurately fitted and lettered. Styles and sizes: ten different regular styles; full arch and half-arch fronts; Dutch oven fronts; smoke extension fronts, full and half-creamery fronts. Made in sizes from 30 inches to 84 inches."

"Chipping as a Fine Art" is one of the subjects treated upon in Bulletin 101, published by the Duntley-Dayton Company, 1416 Michigan avenue, Chicago, Ill. "A casing, a piece of boiler plate or a steel billet, and an ambitious workman with the right kind of chipper in his hands—and watch the chips fly. See how he bends over his work; see how he turns and tilts the hammer to the proper angle; see the pride he takes in his dexterity. Ask him what he most desires in a chipping hammer, and he will say, 'Give me one with power and speed above all things; one with just enough vibration to know that she is hitting; one whose stroke you can regulate from the lightest tap to the hardest blow; one that stands up under the strain of heavy work, and spends its time on the chipping floor rather than in the repair shop.' The Duntley-Dayton chipping hammer meets these specifications, which accounts for its popularity wherever there is much chipping to do. Among the twenty sizes and styles you will find chippers suitable for boiler plate, steel billets or gray iron castings, and for light or heavy work. For riveting, chipping, calking, flue beading, scaling and all other purposes for which pneumatic hammers are used, there is a Duntley-Dayton that will meet the requirements."

Punching and Shearing Machines are described by the Beatty Machine & Manufacturing Company, Hammond, Ind., in a catalogue recently issued. "Our No. 7 single-end punch and shear, with 25-inch throat depth, capacity 1¼-inch hole through 1-inch plate, with architectural jaw with front filler block removed and triple selective gag socket punching tools assembled. These tools are furnished in single, double or triple units. With this equipment three different diameter of punches may be assembled on machine at one setting, permitting a piece of work with three different diameter of holes to be completed in one handling. Especially adapted for boiler shops, steel car and structural works, as they are suitable for flanges, webs, plates and miscellaneous shapes. Built in throat depths from 15 to 72 inches. We also have a complete line of standard patterns in a variety of sizes."

"How to Produce Boiler Efficiency With Minimum Expense" is told in Booklet W, published by the Wager Furnace Bridge Wall Company, Inc., 149 Broadway, New York. "The Wager furnace bridge wall has proved its value in actual use under all conditions. It has been giving economical service for years without repairs in the fleets of many of the steamship and railroad companies, as well as scores of ships for the United States Government. Equally serviceable for marine or stationary boilers, using either hard or soft coal. Send for Booklet 'W,' containing information of vital interest concerning boiler efficiency, together with a list of installations, which is in itself the strongest kind of indorsement of the Wager furnace bridge wall."

Extracts from Smooth-On Instruction Book No. 16 are published in vest-pocket size by the Smooth-On Manufacturing Company, Jersey City, N. J. Smooth-On Iron Cements, Nos. 1 and 2, are described as follows: "Smooth-On Iron Cements Nos. 1 and 2 are chemically prepared iron compounds made and sold in a powder form and used by mixing with water to the consistency of stiff putty. No. 1 is quick hardening. No. 2 is slower hardening and hydraulic. These cements are unequaled for stopping leaks of steam, water, fire or oil, because they become metallic iron that has the same expansion and contraction as iron, thus keeping the joint tight at all temperatures, and joints can easily be taken apart."

"What Staybolts Must Do" is told in a circular issued by the American Flexible Bolt Company, 50 Church street, New York. "Staybolts must hold the sheets against pressure. If the sheets never moved relative to each other there would be no staybolt problem and rigid bolts would do. But sheets do move every time the boiler is fired up. Every time the fire-door is open the firebox breathes. The sheets move very slightly, but they move. It is not enough that the bolts should provide for motion of the sheets. They should provide this motion without buckling the fire sheet. This is why American staybolts have a flexible body that yields to bending. It is why they add life to firebox sheets."

A Steering Gear Catalogue has just been published by the American Engineering Company, Philadelphia, Pa. This is a fully illustrated 28-page booklet which should be in the hands of every one of our readers interested in this subject. "For more than fifty years the American Engineering Company and its predecessors, the American Ship Windlass Company and Williamson Bros., have been developing a line of marine auxiliary machinery, the chief characteristics of which are reliability, durability and accuracy of operation. The scope of these products does not permit detailed discussion of all the variations which could be made to meet peculiar conditions. Our aim, therefore, is to give concise descriptions and information which will enable customers to determine the general characteristics of the various types of equipment. Special problems should always be the subject of consultation. We shall be pleased to assist at any time in their solution as regards the selection or adaptation of any of our products. To keep pace with the rapid advance of marine auxiliary equipment, our engineering department is constantly studying to better our standard machinery or perfect new types which show improvement over the old. Hence some of the illustrations in this catalogue show designs superior to those in our last edition. On the following pages we briefly describe our standard line of steering gear, a subject of utmost importance to the safety of the ship. Generally speaking, the subject of steering gear is divided into three groups: Hand steerers, transmission systems and power steerers. Each of these groups serves a particular function in connection with steering."

Heavy Duty Oil Engines are described in a bulletin recently issued by the Pittsburgh Filter & Engineering Company, Pittsburgh, Pa. "The Type M. V. heavy duty marine oil engine manufactured by the Pittsburgh Filter & Engineering Company, of Pittsburgh, Pa., embodies the well-established and successful method known in Europe for many years as the Brons principle and in the United States as the Hvid principle. These motors have the economy of the Diesel type without its complication, and their use is particularly recommended where 'engine service' and economy are expected. The motor is entirely independent of any carburetor, hot bulb or plate, spark plug, high-pressure air compressor and storage tanks, fuel pump or spray valve. The compression is carried to approximately 500 pounds per square inch, and the motor is started from cold without preheating and put under full load in a few seconds. These motors will burn any grade of the cheaper fuels, from kerosene to the heaviest of fuel oils, the same fuel serving for starting the motor."

How to flange Corners with the McCabe flanging machine is explained in the booklet "A Solution of Your Flanging Problems," published by the McCabe Manufacturing Company, Lawrence, Mass. "This sturdy machine is simple to operate; requires but small shop space, and is a self-contained unit. The McCabe can be easily moved from job to job, and is ready for operation when connected by a hose to your shop compressed air line. Worth-while savings are soon noticeable, and production is secured by the minimum of effort from your workmen."

Lunkenheimer "Renewo" Valves are described in illustrated booklet No. 535-B S, just published by the Lunkenheimer Company, Cincinnati, Ohio. "Minimum wear and absence of trouble because of the practical and scientific construction of all parts—especially the seat-ring and disc—account for the exceptional service Lunkenheimer 'Renewo' valves give. The parts subjected to the most wear—the seat-ring and disc—are made of a hard nickel alloy, a material having extreme wear-resisting qualities. The disc is provided with the well-known Lunkenheimer 'seat guard,' which materially aids in preserving the seating faces and keeping them clean, and both the seat-ring and disc, and all other wearing parts, are easily renewable, making the valve exceptionally durable. The 'Renewo' is made in globe, angle and cross, with inside screw and with outside screw and yoke; straightway or Y and horizontal and angle check patterns, for 200 and 300 pounds working steam pressure."

HELP AND SITUATION AND FOR SALE

☞ *No advertisement accepted unless cash accompanies the order.*

Advertisements will be inserted under this heading at the rate of 4 cents per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent per word. But no advertisement will be inserted for less than 75 cents. Replies can be sent to our care if desired, and they will be forwarded without additional charge.

Wanted—MARINE ENGINEERING for 1917. Unbound preferred. Address *Hewitt's Bookstore,* Long Beach, Cal.

Marine Hardware Firm in New York wants as factory representative or distributor line selling to Drydocks and Ship Repair Yards. Address *Business Opportunity,* care of MARINE ENGINEERING.

Wanted—Naval Architect and Marine Engineer, with teaching and practical experience, to take charge of a department in an Eastern University. Applicants please state full experience and salary desired. Address *Eastern,* care of MARINE ENGINEERING.

Wanted—First-Class Ship Draftsmen for shipyard in New York district, building 9,000- to 10,000-ton steamers. Answer in full regarding age, salary, when ready to start, etc., etc. Address *Ship Draftsmen,* care of MARINE ENGINEERING.

New Marine Oil Engines for sale—six 100 horsepower absolutely new marine oil engines, Fairbanks-Morse C. O. semi-Diesel engines, complete with air and electric starting devices. For information write *Inland Navigation Company,* Security building, St. Louis, Mo.

Hull Draftsman—Nine years' experience, construction and detail, both naval and merchant vessels, desires position around New York. Present employed. Address *Hull Draftsman,* care of MARINE ENGINEERING.

Shipbuilder—Open for suitable responsible position; last employed as Superintendent of hull construction; capable man in drafting office. Over 20 years' varied experience, principally on small and light draft river work. Address *Box* 779, care of MARINE ENGINEERING.

For Sale—One Wheeler Admiralty type Surface Condenser, 1,080 square feet cooling surface, and complete with 12 x 14 x 14 x 14 combined air and circulating pump. Condenser is in good operating condition and being displaced by larger unit. For further particulars address *Texas Star Flour Mills,* Galveston, Tex.

Naval Architect and Marine Engineer released from Naval Service desires position. Twenty years' experience, inspections, appraisals, supervision construction, repairs, trial trips specialty. Chief Engineer's license. North Atlantic preferred. Address *Naval Engineer,* Postoffice Box 3624, Boston, Mass.

An Engineering Sales Corporation located in Philadelphia intends to broaden line and will be glad to hear from manufacturers of specialties for railroad, shipbuilding and industrial plants, desirous of establishing exclusive selling agency in this territory. Address *Specialties,* care of MARINE ENGINEERING.

Wanted—Technical Graduates familiar with Marine Engineering specifications, first-class marine engine, electrical and pipe draftsmen. Permanent positions for right men in shipyard near New York City. Address *Graduate,* care of MARINE ENGINEERING.

Superintendent, steel hull construction in medium or small yard; Foreman of loft or Shipfitters in medium or large yard; age 39. Experience from boyhood in charge of mechanics. A past-master of modern loft work. Any shipbuilding firm desirous for a first-class man as mentioned, please address *Box* 667, care of MARINE ENGINEERING.

Engineer, 39, mechanical and marine, with scientific training, B. Sc. (Glasgow) Associate Member, Institution Civil Engineers (London), and years of practical experience in works, also was Lloyd's Surveyor, is open for engagement. Has a perfect knowledge of Russian and German. Address *Box* 850, care of MARINE ENGINEERING.

Consider this Advertisement if you wish a high-grade man. At age of 14 entered three years' apprenticeship in shipbuilding and attending Evening Technical School during that time; at age of 17 entered woodworking shop as machine hand; cabinetmaker and foreman for three years. Spent one year in Technical School; graduated, received diploma; then one year on mechanical work, another year in Technical College; graduated, received second diploma. Two years as Mechanical Draftsman, three years on designing and production engineering; for past two years on Emergency Fleet work as leading draftsman on joiner work. Continuation of evening schools, keeping in touch with the latest and best books and trade publications, have given me a broad knowledge of modern production methods. A young man of energy, knowledge and ambition, now in his thirty-first year, desires to make permanent connection with shipyard or industrial organization in executive position, preferably combination of steel and woodworking in planning department or on production work. Address *Production,* care of MARINE ENGINEERING.

For Sale at a Bargain, six used marine projector searchlights, complete with dispersion lenses and rheostats; 220-volt D. C. Carlisle & Finch Company's make. Form 1-M, plain hand-controlled, 14 inches. Have been in use for one year. Good as new. Make us an offer. *American Rolling Mill Company,* Middletown, Ohio.

Marine Refrigeration—All-around Engineer, Practical and Technical, with many years' experience, marine (and land), with leading British firms, CO_2 and NH_3 systems, and all classes of cargo and provision carrying, who have ORIGINATED CO_2 refrigeration with British firm, desires post with American engineers to commence refrigeration in new shipbuilding. Can carry job through, *i. e.,* estimation, design (on blank sheet, not copy), manufacture, erection, running, etc. Address *Marine Refrigeration,* care of INTERNATIONAL MARINE ENGINEERING, 8 Bouverie street, London, E. C. 4.

Kelly Rocking and Dumping Grates are described in Catalogue "C," published by the Kelly Foundry & Machine Company, Goshen, Ind. "The construction of the Kelly grates offers least resistance to the passage of air, and at the same time supports the fuel; movable for the sifting of ashes and dumping of clinkers and easily operated. Few parts, properly designed, reduces the cost of maintenance to a minimum, and each set is guaranteed to give satisfaction. No special furnace construction is necessary to make installation, as grates are supported at front and rear of furnace by regular gate rests. Write for our Grate Catalogue 'C.'"

The General Industrial Catalogue of TYCOS instruments, containing 422 pages of useful and interesting temperature information, is now ready for distribution. This new publication describes the whole line of TYCOS instruments for the indicating, recording and control of temperature. Many special applications are illustrated, showing the manner in which TYCOS instruments can be adapted to diverse temperature needs. Practically every instrument manufactured by the Taylor Instrument Companies, Rochester, N. Y., for industrial purposes is illustrated, and much explanatory matter descriptive of their construction and principles of operation is given. The list includes thermometers of every description, index and recording thermometers, hydrometers, pyrometers, temperature and pressure regulators, barometers, absolute pressure and draft gages. A handsome publication, well bound, printed on paper of excellent quality and illustrated throughout with line drawings and half-tone cuts.

Complete Machine Tool Equipment for ship and navy yard use is described in catalogues published by the Niles-Bement-Pond Company, 111 Broadway, New York. "The excellence and stamina of Niles-Bement-Pond machine tools have been amply demonstrated by their record in American ship and navy yards in the two years just past. Built to handle big work in a big way, they have stood up under the trying strain of greatly increased production and have made good without exception. No matter how large the equipment needed, we have ample capacity to turn it out right. We have built bending and straightening rolls up to 36 feet wide, armor plate planers with 14-foot working width, boring and turning mills with 42-foot swing. Niles electric traveling cranes have capacities up to 250 tons and over."

"Wire Specialties for Ships" is the title of an illustrated 8-page catalogue just published by Oliver Whyte Company, Inc., Boston, Mass. "This 'Wire-Talk' is intended for shipbuilders everywhere as a distinct contribution to speeding up their work in so far as it concerns equipment made of wire, light or heavy, no matter what special designs are required. For nearly half a century we have been making to order wire goods of unlimited variety. Long experience and excellent facilities enable us to furnish—and furnish quickly—whatever you need made of wire, especially the various odd-shaped wire goods you find it impossible to get elsewhere. We are also prepared to make to order, for quick delivery, certain articles of sheet steel and light steel shapes. All our work is done by expert wireworkers. Our service experts are at your free disposal, if desired, to co-operate in the preparation of sketches, designs, blueprints, etc., and to offer practical suggestions."

Timed Lubrication for heavy oil marine engines is described and illustrated in a circular issued by the Richardson-Phenix Company, 120 Reservoir avenue, Milwaukee, Wis. "Efficient lubrication of a heavy oil marine engine means its success or failure. It is not efficient lubrication merely to force large quantities of oil into the engine cylinders. When does the oil enter the cylinder? What is the position of the piston? On what portion of the piston is the oil placed? The answers to these questions determine whether your engine is being efficiently lubricated. Lubricating oil should be introduced into the cylinders at each piston stroke, at the time when it will be least affected by the explosion heat, and at the place where it will receive the greatest distribution in the least possible time. Only the Richardson Model 'M' Lubricator can accomplish these results. It is not a ratchet type lubricator; it is different from all other lubricators in principle; it is the only lubricator that accurately times the introduction of the oil into the cylinder."

A Few Uses from the Thousand and One you can find for Smooth-On No. 1 are told in a circular published by the Smooth-On Manufacturing Company, Jersey City, N. J. "If a bolt needs a washer or lock nut, and you wish a permanent job, use Smooth-On No. 1. If you wish to imbed expansion sockets in cement so they will not come out, use Smooth-On No. 1. If you wish a permanent lock nut, fasten the nut to the bolt by applying some Smooth-On No. 1 to the threads."

Water Tube Boilers.—Messrs. J. Samuel White & Co., East Cowes, Isle of Wight, have recently issued a very complete and fully illustrated catalogue describing their boilers, engines and vessels of various kinds. The introduction to the catalogue describing the White-Forster type of water tube boilers gives the following interesting information: We have, since 1885, been makers (and users) of watertube Boilers for various types of vessels, but principally in connection with high-speed vessels, where the conditions of working are severe. The types made by us have been evolved to meet conditions fully and economically, and at the same time to embody the features essential to efficiency and durability, viz.:—1. Simplicity in design and construction. 2. Facility for inspection, cleaning and repair. 3. Ample steam space in proportion to the heating surface. 4. All parts of mild steel. 5. Constructive details based on established boilermakers' practice. In any type of watertube boiler the question of removal and renewal of any or all of the tubes is a very important one—our experience points to the following conditions in the lifetime of a boiler when this is necessary or desirable:—1. During manufacture a tube in the middle of a nest may fail at the last stage of expansion by tube expander. 2. A tube may fail under water pressure test of completed boiler. 3. On inspection of boilers by Receiving Officers after trial, they may discover some point in connection with any one tube and wish it removed. 4. On periodical inspections of conditions of boilers in accordance with instructions for ships in Reserve, or in Commission, a sample tube from each row will reveal the actual condition. 5. Probably the rows next the fire, if the service has been very severe, or the use of the Fire Extinguisher has been injudicious, might require renewal before any other tubes in the boiler. 6. As the result of an accident caused by a burst tube. 7. Complete renewal owing to fair wear and tear. The 'White-Forster' Boiler is designed so that the above conditions can be met with no more difficulty than is experienced in a firetube boiler, and all the necessary repairs can be made by the ship's staff. We have constructed boilers in one unit to supply steam for 100 up to 10,000 S.H.P.—the larger units being oil fired."

MARINE SOCIETIES

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS
Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS
29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS
29 West 39th Street, New York City.

UNITED STATES NAVAL INSTITUTE
Naval Academy, Annapolis, Md.

AMERICAN ASSOCIATION OF MASTERS, MATES AND PILOTS
National President—John H. Pruett, 423 Forty-ninth St., Brooklyn, N. Y.
National Treasurer—A. B. Devlin, 187 Randolph Ave., Jersey City, N. J.
National Secretary—M. D. Tenniswood, 808 Vine St., Camden, N. J.

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Vice-President—W. A. Leavitt, Jr., New York Shipbuilding Corporation, Camden, N. J.
Secretary—B. G. Barnes, 1596 North Ave., Bridgeport, Conn.
Treasurer—J. B. Sadler, P. O. Box 987, Norfolk, Va.

MARINE ENGINEERS' BENEFICIAL ASSOCIATION NATIONAL OFFICERS
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National Secretary—Geo. A. Grubb, 356 Ellicott Square Bldg., Buffalo, N. Y.
National Treasurer—Albert L. Jones, 38 Avery Avenue, Detroit, Mich.

CANADA

GRAND COUNCIL, N. A. OF M. E. OF CANADA
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Grand Vice-President—E. J. Belanger, Bienville, Levis.
Grand Secretary-Treasurer—Neil J. Morrison, P. O. Box 886, St. John, N. B.
Grand Conductor—J. W. McLeod, Owen Sound, Ont.

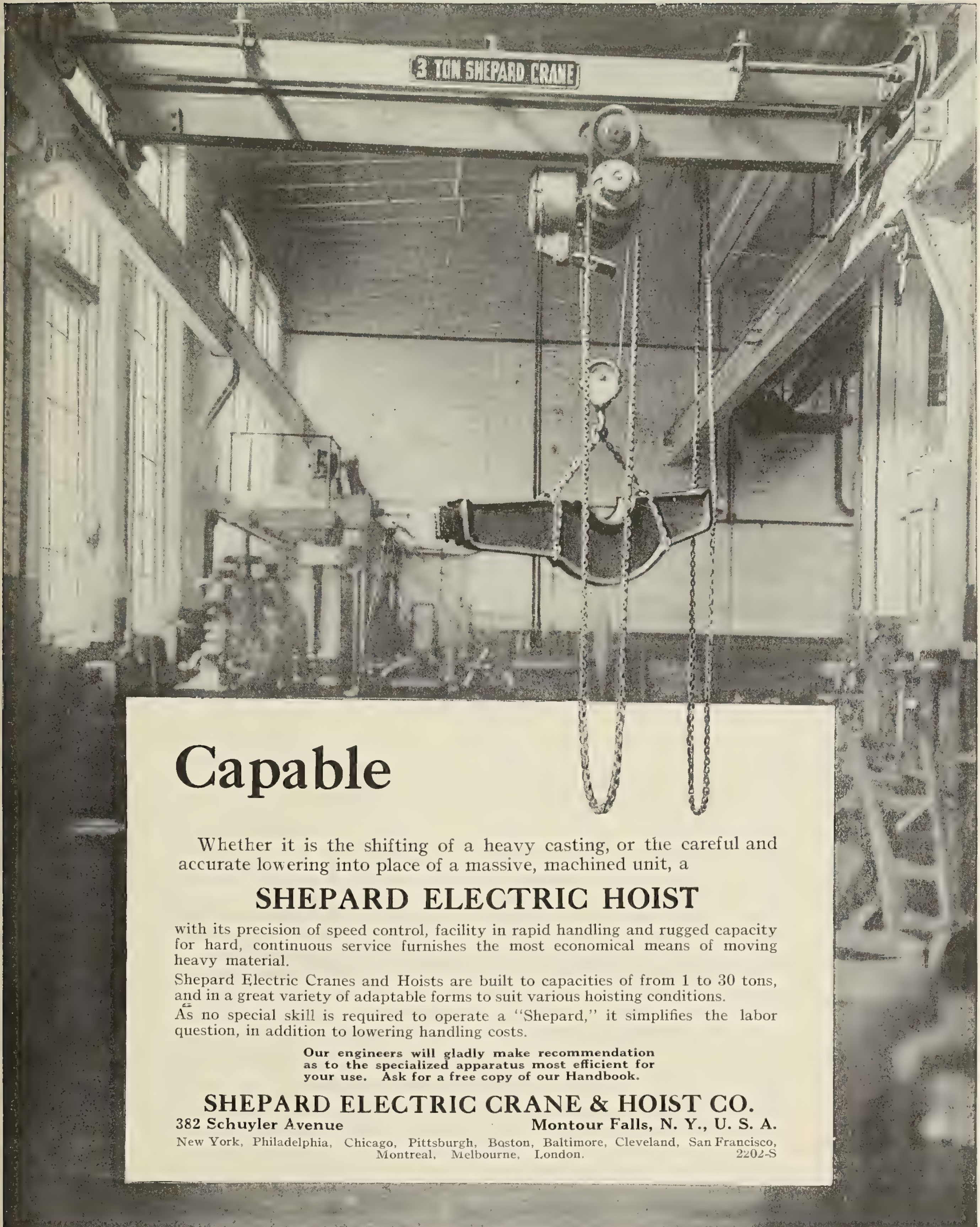
GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND
39 Elmbank Crescent, Glasgow.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORPORATED
The Minories, Tower Hill, London.



Capable

Whether it is the shifting of a heavy casting, or the careful and accurate lowering into place of a massive, machined unit, a

SHEPARD ELECTRIC HOIST

with its precision of speed control, facility in rapid handling and rugged capacity for hard, continuous service furnishes the most economical means of moving heavy material.

Shepard Electric Cranes and Hoists are built to capacities of from 1 to 30 tons, and in a great variety of adaptable forms to suit various hoisting conditions.

As no special skill is required to operate a "Shepard," it simplifies the labor question, in addition to lowering handling costs.

Our engineers will gladly make recommendation as to the specialized apparatus most efficient for your use. Ask for a free copy of our Handbook.

SHEPARD ELECTRIC CRANE & HOIST CO.

382 Schuyler Avenue **Montour Falls, N. Y., U. S. A.**

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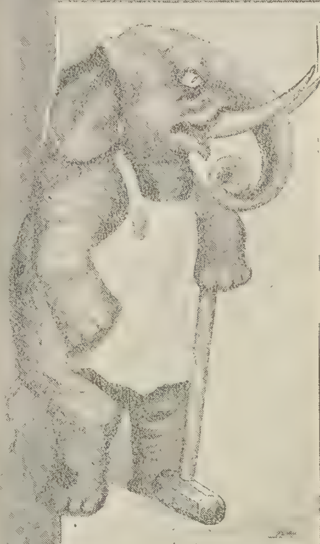
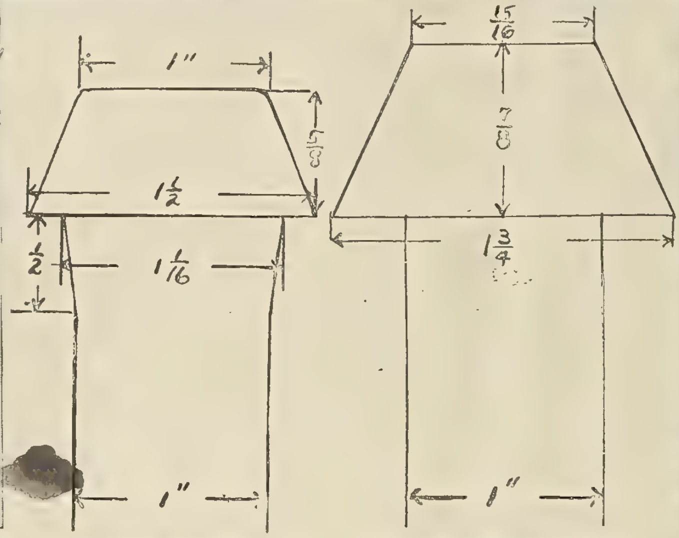




Pan Head, Swell Neck

Cone Head, Straight Neck

Now that the war is over and we can all work in conformity with the laws governing first class workmanship, we respectfully suggest:

The great advantage of using Swell Neck Rivets for Marine purposes, they being freely acknowledged by all the leading Shipbuilders to be of the best design, and endorsed by them in their regular practice.

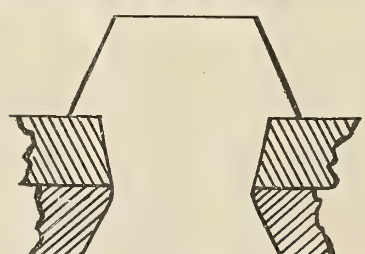
These rivets are made to fill holes in punched plates. The diameter of the punched hole on the die side is always slightly larger than the hole on the punched side. In other words, the punched hole is of conical shape.

In assembling, the plates are reversed, and by the use of Swell Neck Rivets the holes are completely filled, and the production is increased to a maximum, while the loss occasioned by loose rivets is reduced to a minimum.

The strength of the joint is further increased by the use of steel made according to Lloyd's, or U. S. Navy Specifications, which adds at least 5,000 pounds to the shearing strength, and 10,000 pounds to the tensile strength.

Our rivets conform strictly to Specifications. We carry the largest stock of rivet bars and rivets in the world.

ALL SIZES **ALL LENGTHS**



DRIVEN RIVET

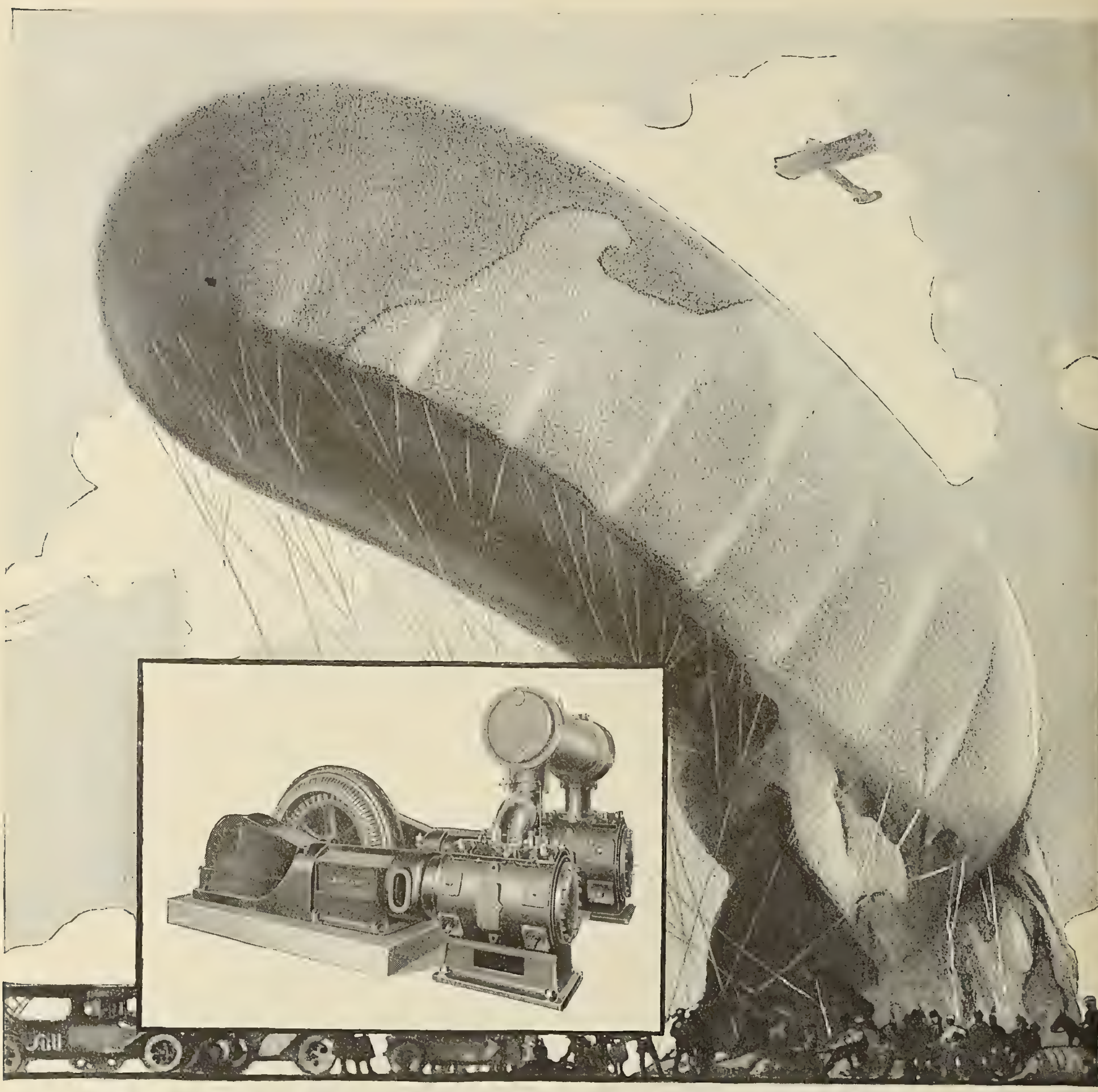
UNBROKEN AFTER 20 YEARS TEST

Booklet "Scientific Facts" upon application

ON EVERY HEAD

THE CHAMPION RIVET COMPANY

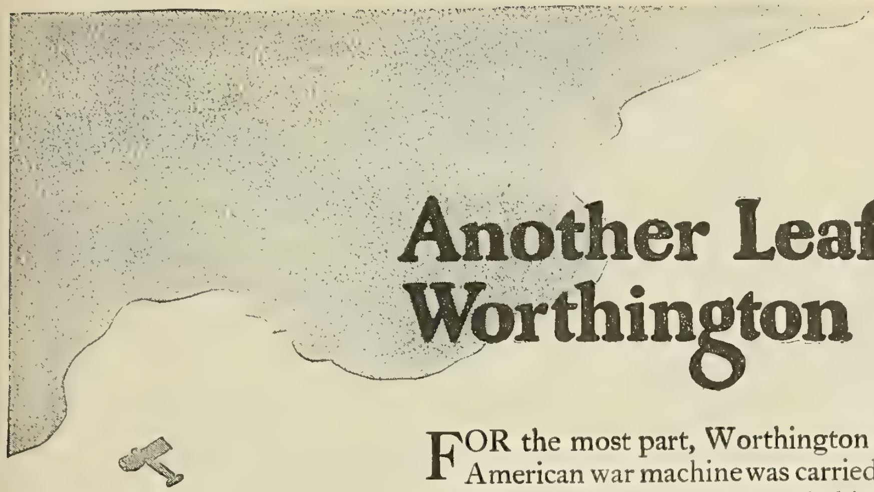
CLEVELAND, O. AND EAST CHICAGO, IND.



PUMPS—COMPRESSORS—CONDENSERS—METERS-

WORTHING

Worthington Works, Harrison, N.J.
Blake & Knowles Works, East Cambridge, Mass.
Deane Works, Holyoke, Mass.
Hazleton Works, Hazleton, Pa.



Another Leaf from the Worthington war book

FOR the most part, Worthington's vital share in forging the American war machine was carried on in "third-line trenches" —in the countless factories and shipyards, or at mines or farms three thousand miles from the front.

But in a few instances Worthington went forward with our troops. Worthington Compressors, made by our Laidlaw Works, for example, were employed in filling cylinders with compressed gas for inflating balloons. Other Worthington Compressors found varied use on our ships of war, from clearing the big guns of gas to emptying flooded compartments or operating machine tools. It was our Laidlaw Works, indeed, which supplied over a hundred compressors for Uncle Sam's new destroyers.

And so throughout the whole big Worthington organization. All the facilities of our eight factories were employed wherever they could speed up war work, and the long list of products delivered—to our government, to military forces, and to industry—constitutes for us both a sweeping endorsement of Worthington quality and a proud roll of honor.

WORTHINGTON PUMP AND MACHINERY CORPORATION
***Executive Offices:* 115 Broadway, New York City**
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-OIL & GAS ENGINES—MINING MACHINERY

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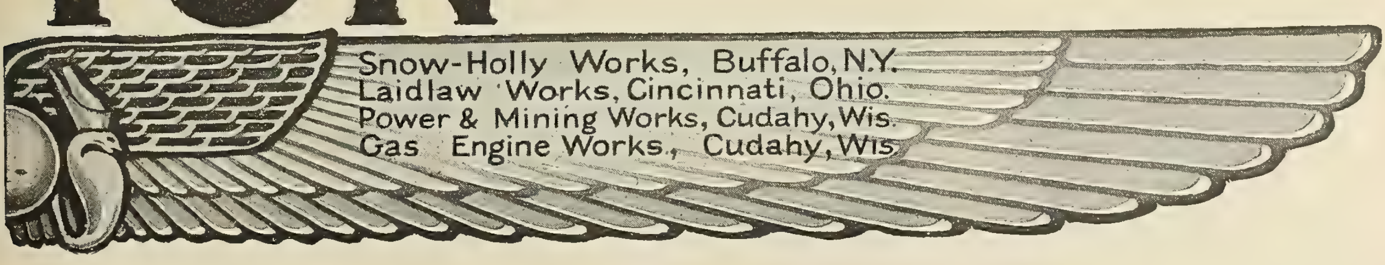
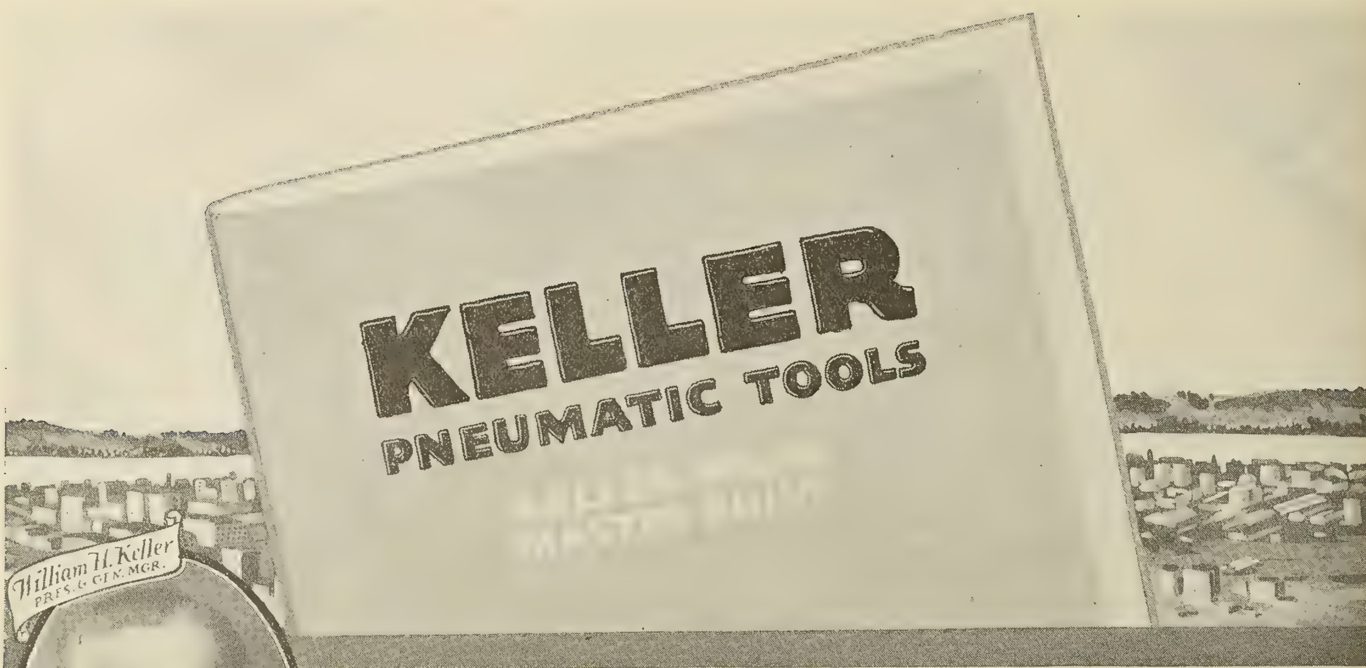
PRODUCTS FOR THE MARINE FIELD:

Vertical Boiler Feed Pumps	Fire Pumps
Oil Circulating Pumps	Sanitary Pumps
Air Pumps	Marine Engines

Special Bulletins on Request.





You Need This New Keller Catalogue

I'm prouder of this new Keller Catalogue, just off the press, than any author ever was of his literary brain-child. To us of the Keller organization it is a brain-child, not in the literary sense alone, but in the mechanical sense as well. It contains our deeds as well as our words. We *made* it before we *wrote* it; and that is why we have been able to put into it a collection of hard facts about Pneumatic Tools and their uses that I am sure will prove of vital interest (and still more vital profit) to every buyer and user of such equipment.

In the new Keller Catalogue you will find pictured and described the line of Master-Built Pneumatic Tools that has been adopted as standard equipment by leading Railroads, Government Shipyards, and a majority of the foremost Shipyards, Shops and Foundries throughout the country.

From the new Keller Catalogue you can now buy *Valve and Valveless Drills* (recent additions to the line), as well as Scaling, Chipping and Riveting Hammers, Holders-on, Dolly Bars, Jam Riveters and Sand Rammers.

There's a Keller-Master tool for every purpose—and every Keller-Master tool is *the best for the purpose.*

If you have not already received a copy of the new Keller Catalogue, it will pay you to drop us a line at once, on your business letterhead, as a means of making sure that you are not overlooked.

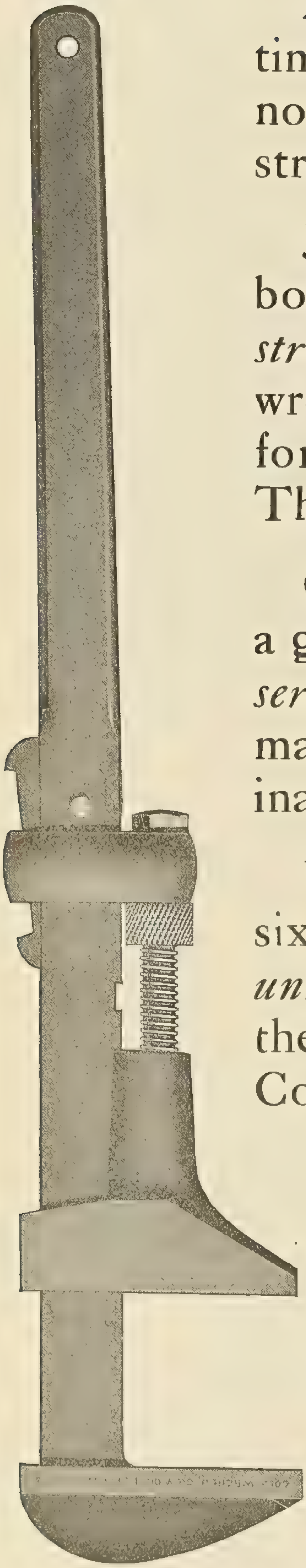
You'll be vitally interested in what the book *says* about Keller-Master tools; you'll find the tools themselves can be depended upon to *do* a great deal more than the utmost that we have ventured to claim for them.

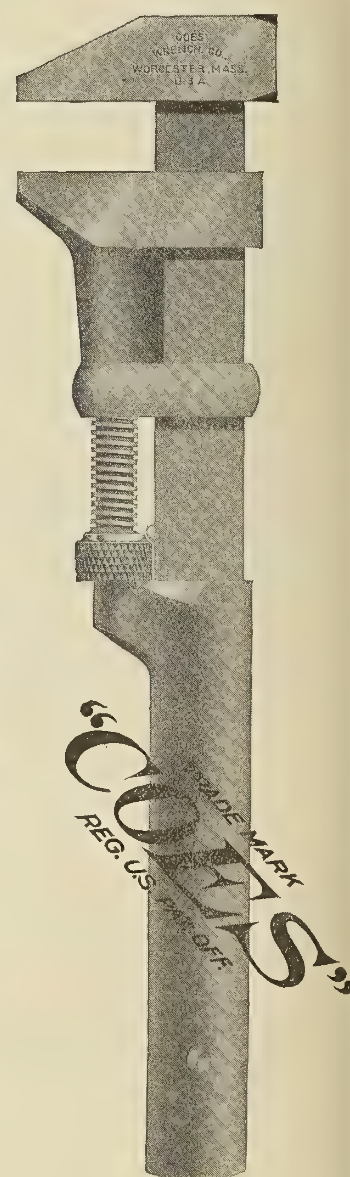
KELLER-MADE
PNEUMATIC TOOLS
MASTER-BUILT

William H. Keller *President*

KELLER PNEUMATIC TOOL COMPANY, GRAND HAVEN, MICH., U. S. A.

General Sales Offices: 20 East Jackson Boulevard, Chicago. Factory: Grand Haven, Michigan




"COES"
TRADE MARK
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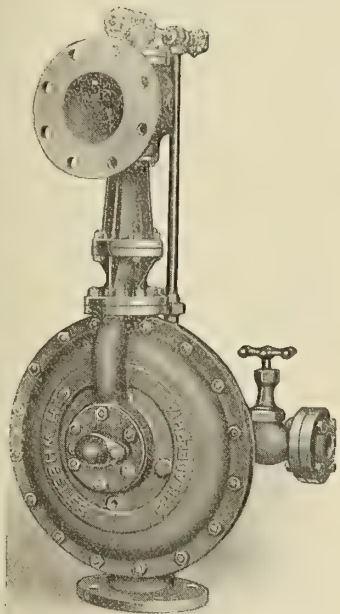
We Specialize in the Design and Construction of Surface and Jet Condensers, Pumps, Etc.

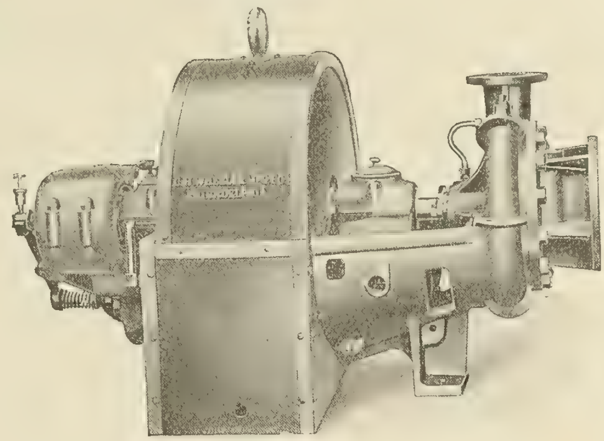


RADOJET

RADOJET AIR PUMPS

Fulfill all the requirements for marine service.

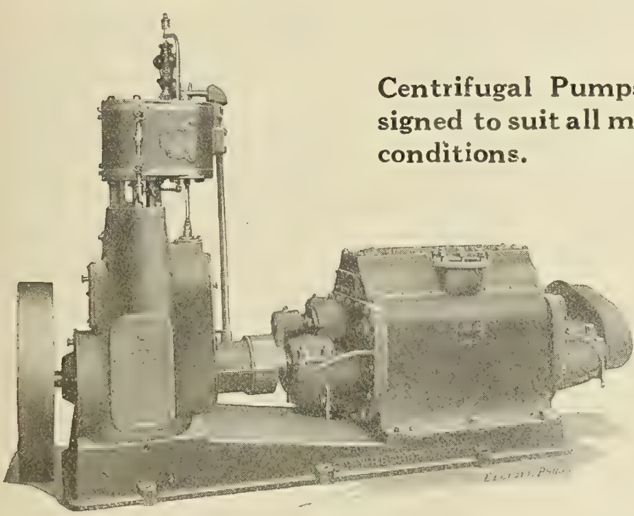
Smallest weight
Reliable and noiseless operation
Highest economy
No moving parts
No lubrication
No foundation



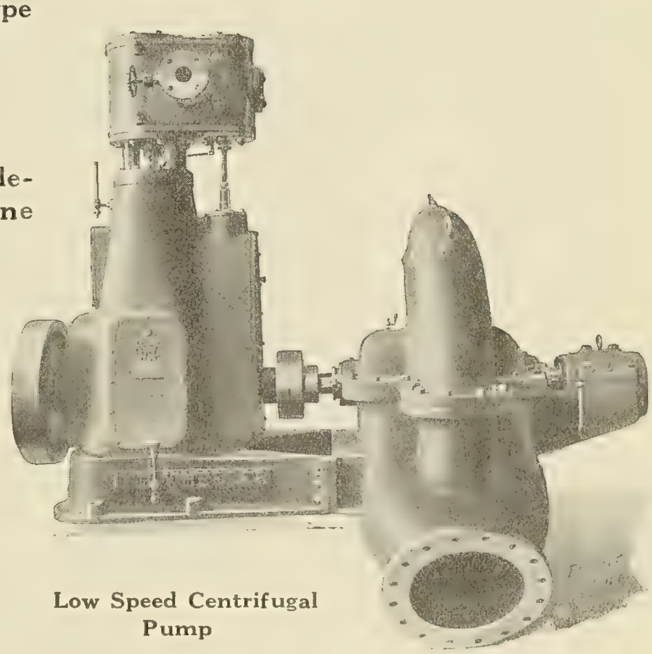
Marine Type Condensate Pump

ROTREX Suction Valveless Rotary Type Vacuum Pump.

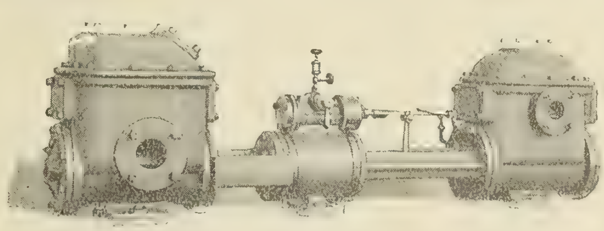
Centrifugal Pumps designed to suit all marine conditions.



ROTREX Vacuum Pump



Low Speed Centrifugal Pump

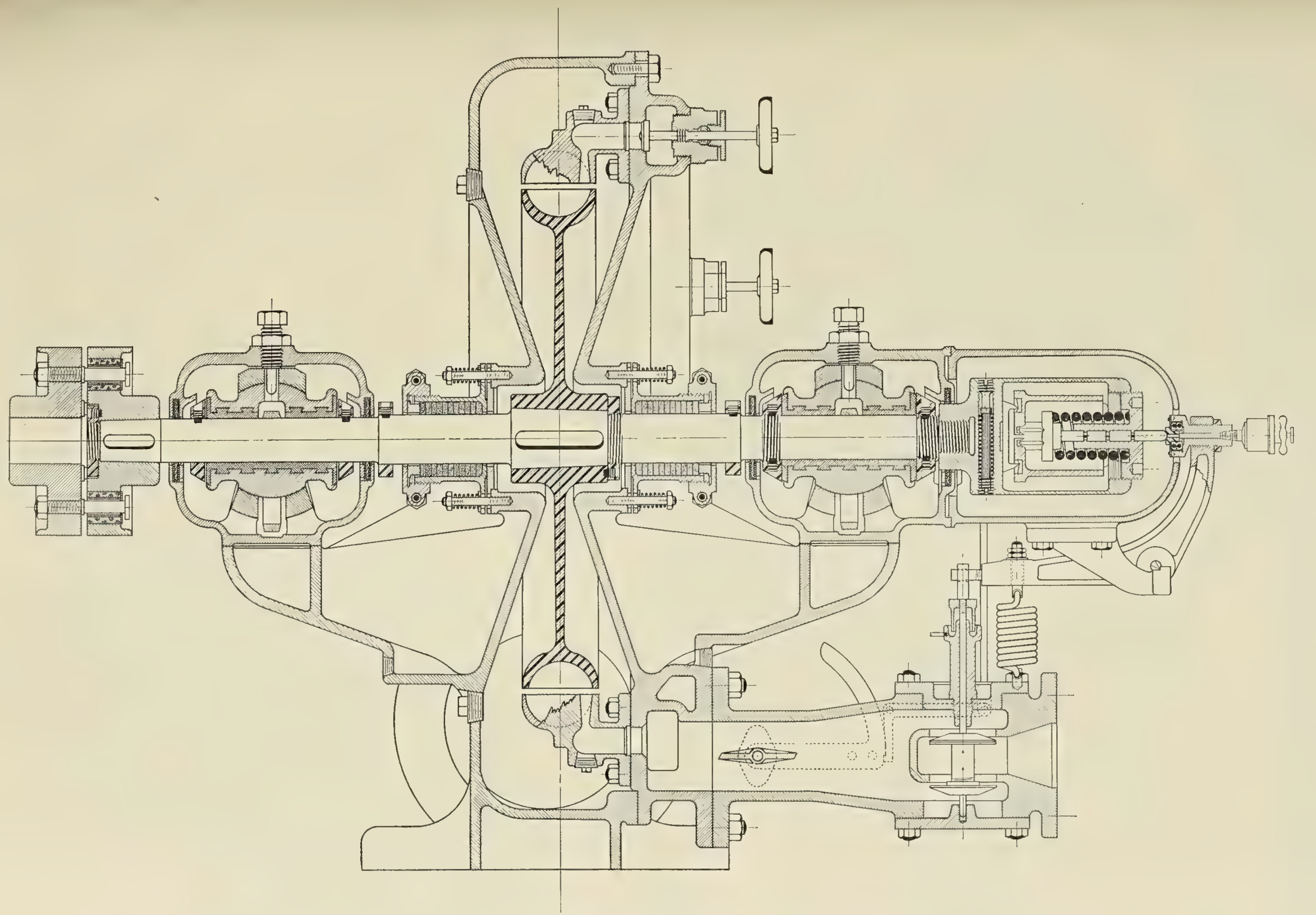


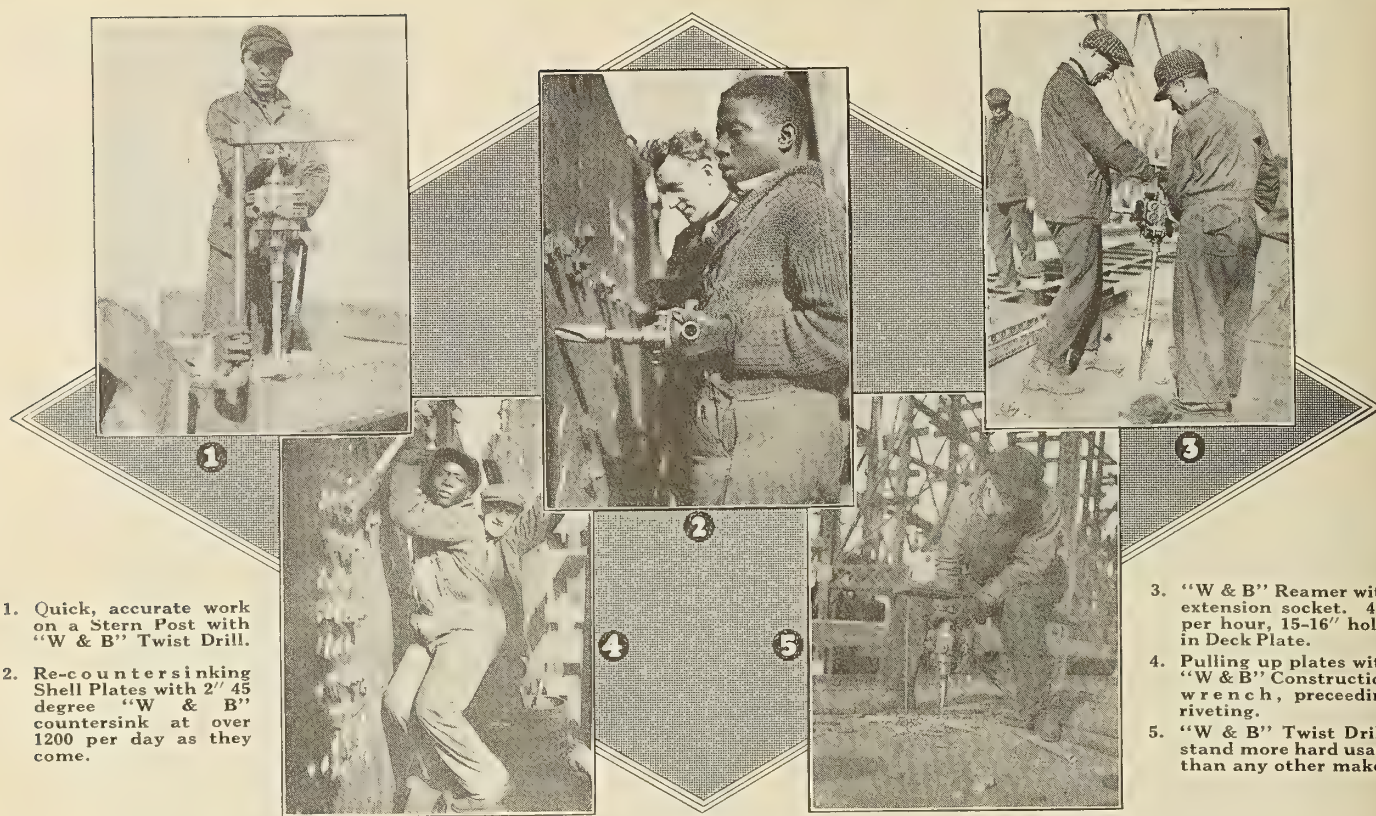
Combined Air and Circulating Pump

C. H. WHEELER MANUFACTURING COMPANY

Main Office and Works: PHILADELPHIA, PA.

Branch Offices: New York, San Francisco, Boston, Seattle, Chicago, Charlotte, Pittsburgh, New Orleans





1. Quick, accurate work on a Stern Post with "W & B" Twist Drill.
2. Re-countersinking Shell Plates with 2" 45 degree "W & B" countersink at over 1200 per day as they come.
3. "W & B" Reamer with extension socket. 420 per hour, 15-16" holes in Deck Plate.
4. Pulling up plates with "W & B" Construction wrench, preceeding riveting.
5. "W & B" Twist Drills stand more hard usage than any other make.

Watch 'em Work!

PUT a good man behind a "W & B" Tool and your combination can't be beat.

With "Hercules" (patented) High Speed Twist Drills and Reamers, holes come fast and accurate in the hardest, toughest steel.

The shipyards that produce the most good holes per Drill and per dollar of Drill cost regularly use "Hercules" High Speed Twist Drills and Reamers on bottom, keel and deck plates, stern posts and general heavy work.

"Hercules" Twist Drills have a collar larger than any other part of the drill —prevents dropping through a finished hole. They are hot twisted from special rolled alloy steel—keeps the original grain of the metal. Thin webs result in fast, clean work. "Hercules" (patented) High Speed Reamers keep pace with "Hercules" Twist Drills.

Other "W & B" Tools for Shipbuilders include our Three Lip Ship Plate Countersinks; a fine set of Spud Wrenches in sizes ¼" to 1¼"; a full line of Carbon and High Speed Twist Drills and Reamers; a more complete line of Screw and Drop Forged Wrenches than is shown by any other manufacturer, and many accessories.

Send us your drawings and specifications for special drop forgings.

Our new No. 91 Catalog now ready.

W&B

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THE WHITMAN & BARNES MANUFACTURING COMPANY

General Offices: Akron, O.

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Established 65 Years

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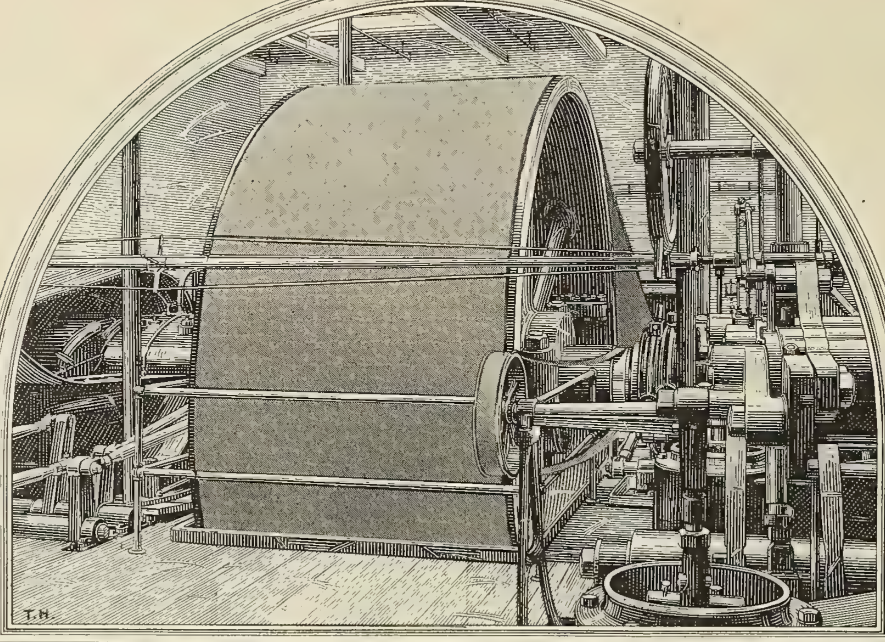
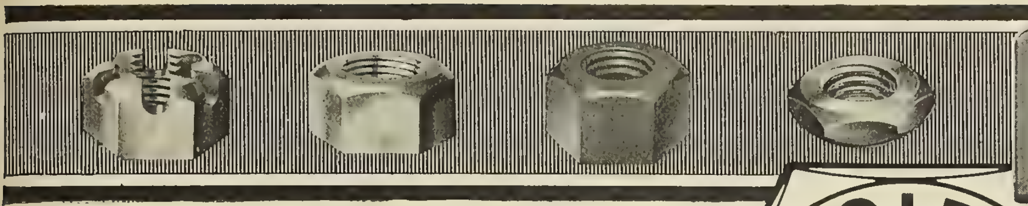
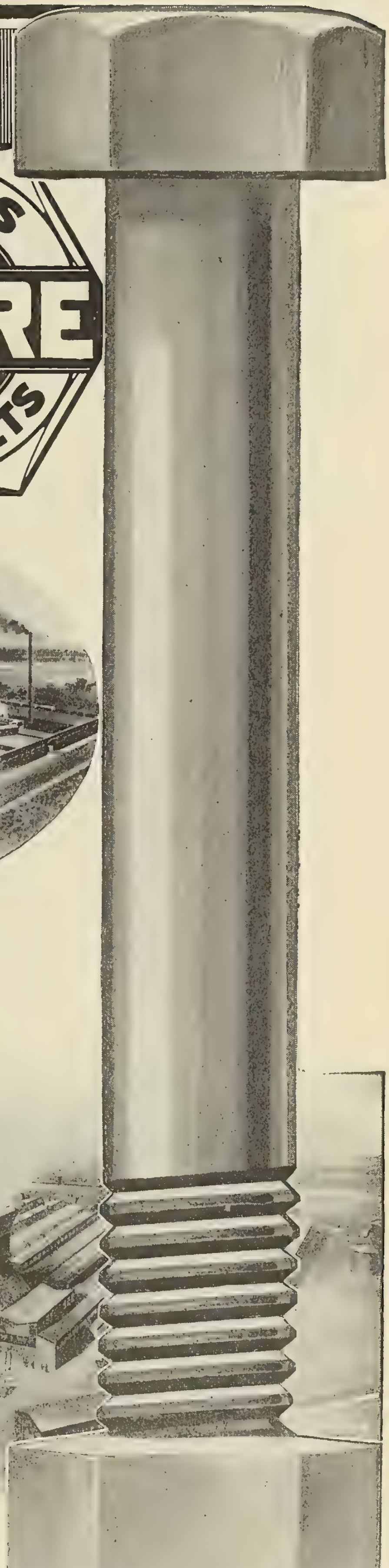
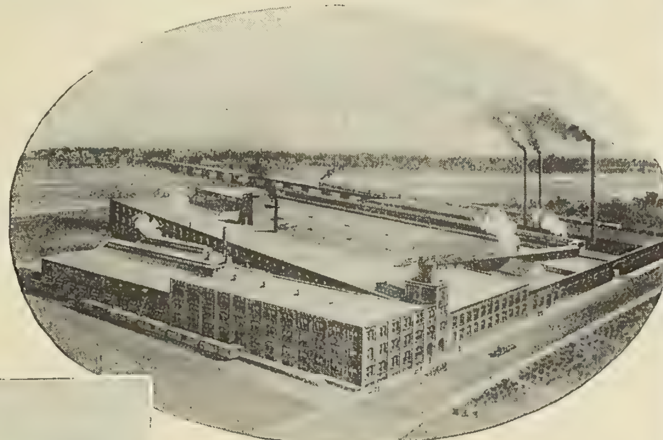
TWIST DRILLS — REAMERS — WRENCHES — DROP FORGINGS

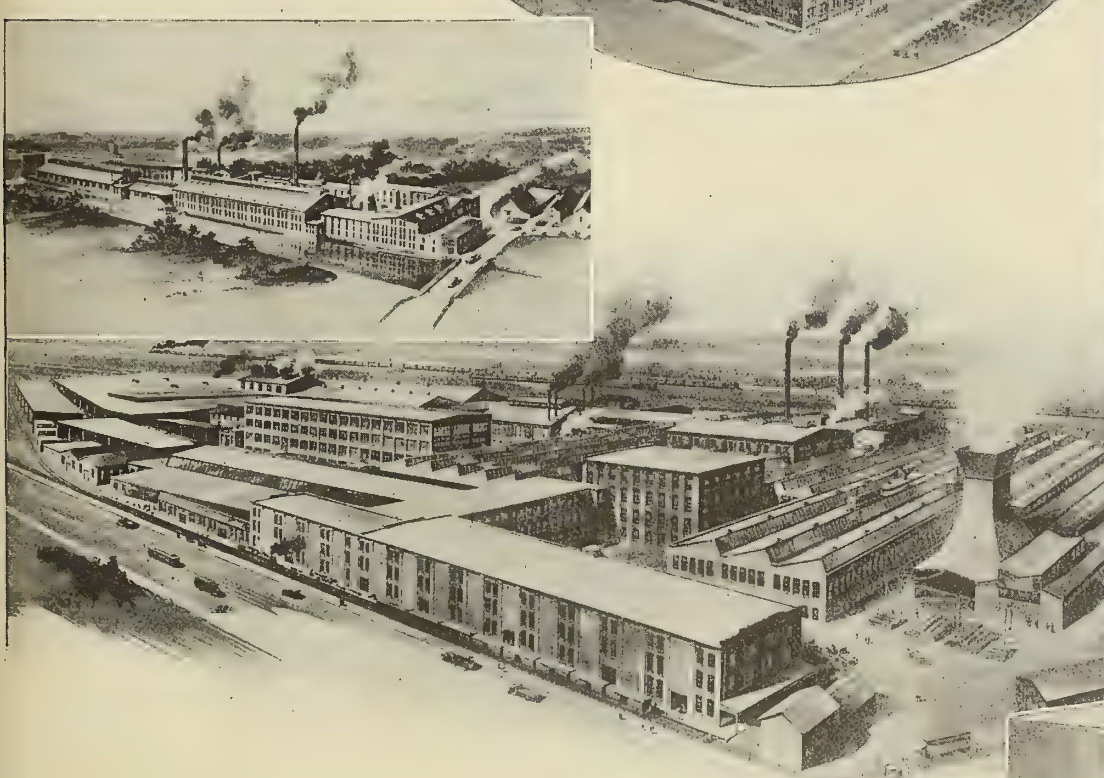


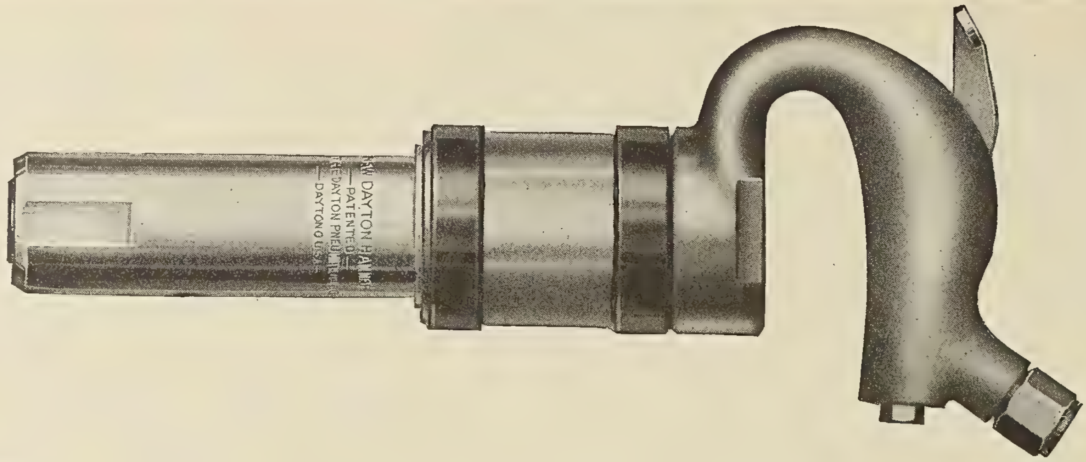
This is an 80-inch 3-ply Heart Brand Belt in a Massachusetts paper mill. It began its service in 1911. It carries 1100 horsepower. The cost of transmitting a horsepower a week is $.0045.











Repair Part Insurance

DUNTLEY - DAYTON TOOLS are designed to keep up the production and keep down the repair bills. He may have been a pessimist who coined the phrase "It isn't the first cost; it's the upkeep," but he was an optimist who conceived the idea of so simplifying the construction of a pneumatic tool that its cost of maintenance would be reasonable. Simplicity of construction and durability are outstanding features to such an extent that investment in DUNTLEY-DAYTON Pneumatic Tools is a form of REPAIR PART INSURANCE that goes with the purchase.

AN INVITATION

You are invited to send for Bulletin No. 101 telling all about DUNTLEY-DAYTON Hammers and pneumatic tool accessories.

You are also invited to send for Bulletin No. 102 which gives the prices of the Repair Parts—an important consideration in the selection of Penumatic Tools. There is a chapter on the "Care of Pneumatic Hammers" in this bulletin which is of interest to the man who pays the repair bills as well as the operator himself.

You are also invited to send for Folder No. 104 entitled Hoseology —a treatise on hose, hose couplings and hose clamp tools.

And you are invited to send us your inquiries for Pneumatic or Electric Tools of any description, and rivet sets, chisel blanks, grease and oil and other accessories.

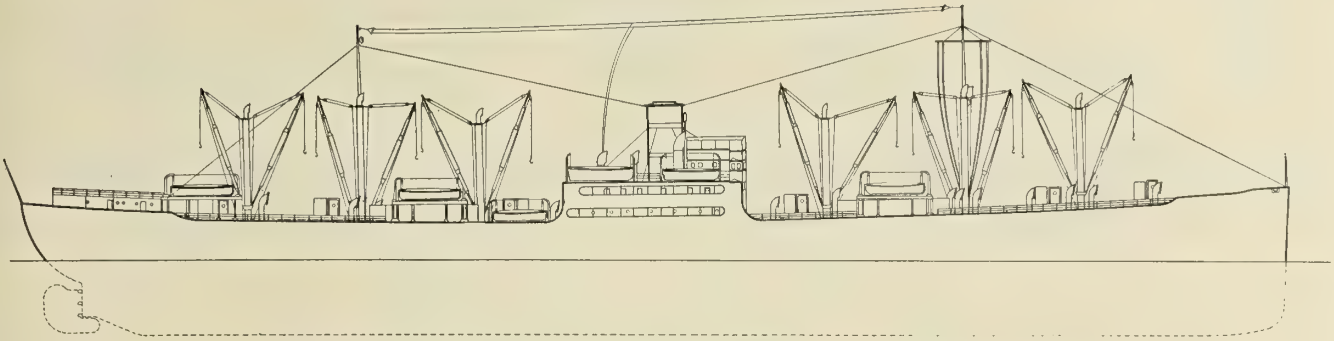
DUNTLEY-DAYTON CO.
Westminster Building
CHICAGO

295 FIFTH AVENUE
NEW YORK

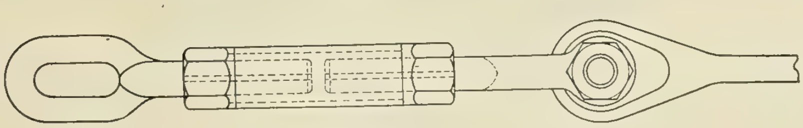
719 COMMERCIAL TRUST
BUILDING
PHILADELPHIA

Office and Representatives in Every Principal City of the World

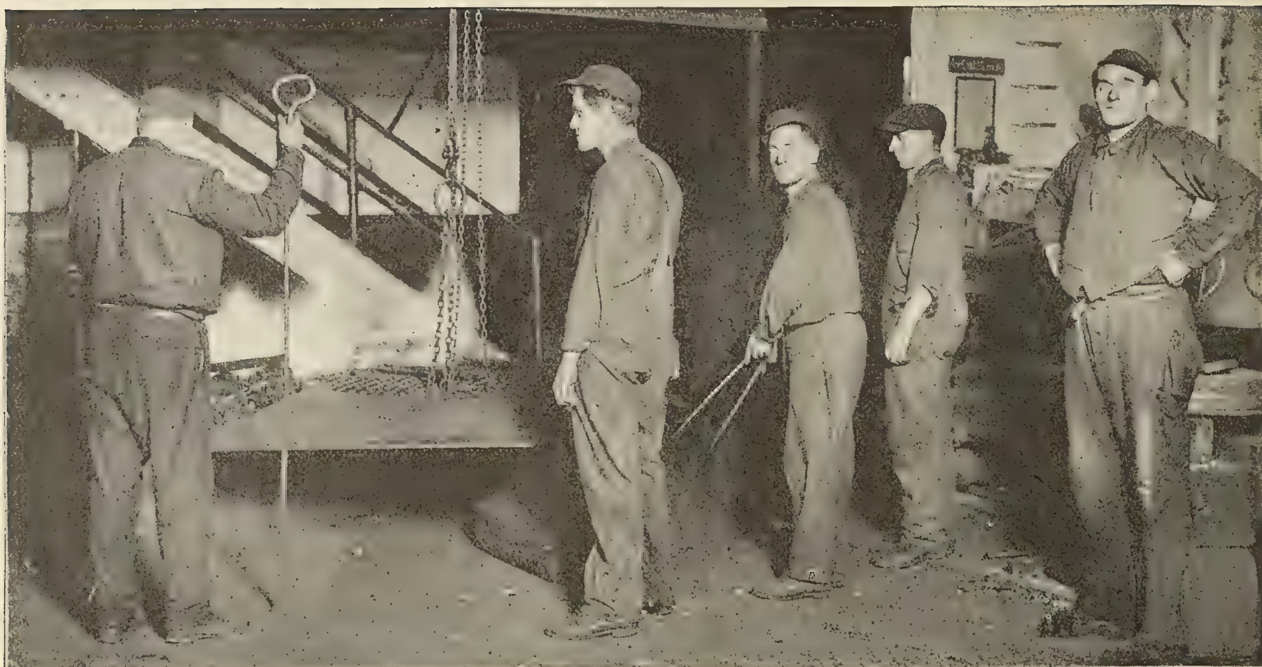
Duntley-Dayton



U. S. S. SOUTH BEND
One of several ships refitted by this Corporation for Army Transport Service.



2½″ Turnbuckle made in our shop.

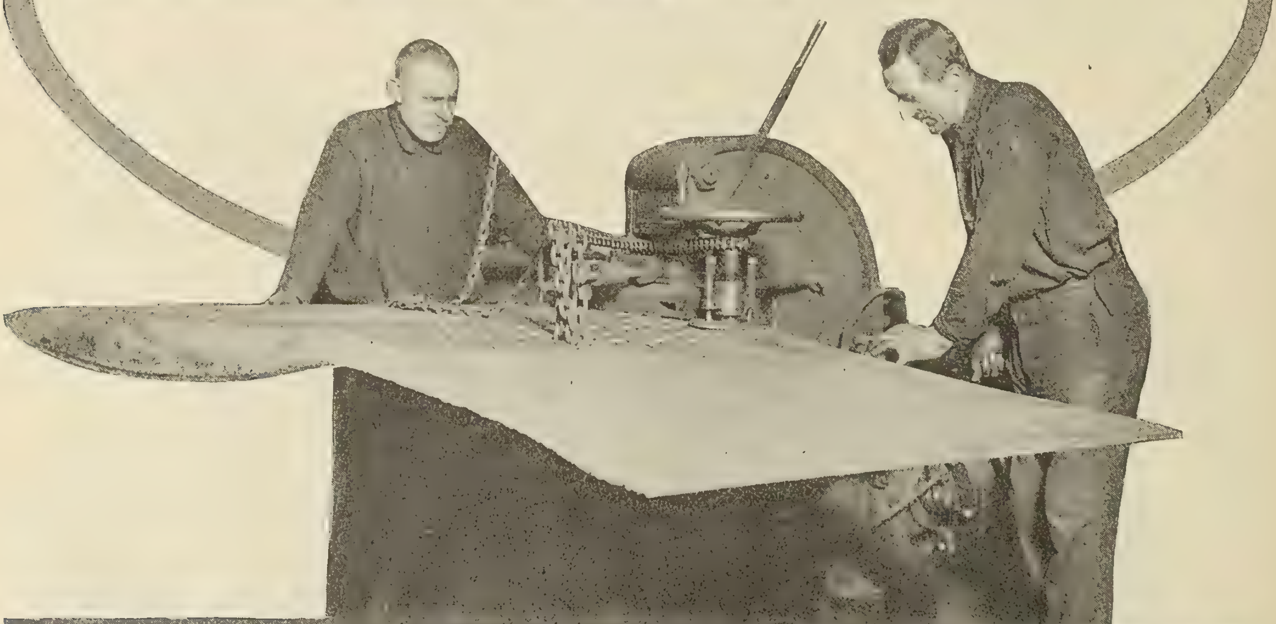


What Does This Mean to Your Shop?

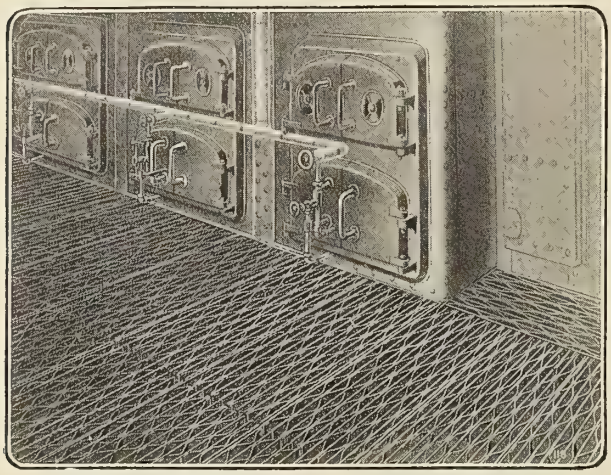
A gang of 5 men to handle flanging under the old style hand flanging methods or 2 men when you use the

McCabe Pneumatic Flanging Machine

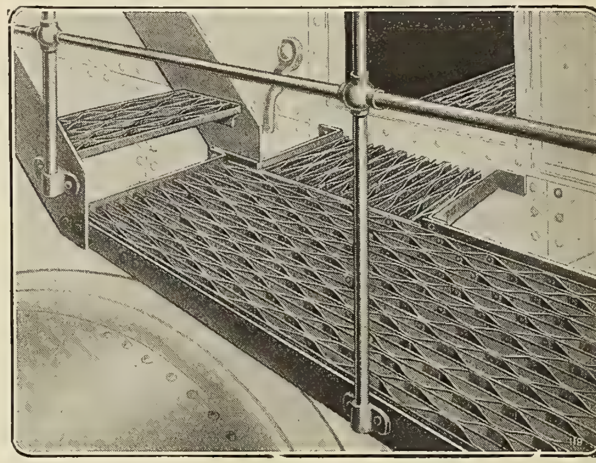
And you notice the increase in production too. The "McCabe" absorbs all the tedious back breaking work of hand flanging, flanges sheets cold $\frac{1}{2}''$ or under in thickness, thus eliminates lost time in waiting for heats, and turns out a sheet true to shape and fit. Just drop us a postal for booklet "A Solution of Your Flanging Problems."



McCABE MFG CO. LAWRENCE, MASSACHUSETTS



Boiler Room Floor in an Oil-Fired Ship



Walkway and Ladders in Ship Engine Room

Don't wait till you need gasket material in a hurry—don't risk holding up a mighty important repair job while you send out and get a cut piece of sheet packing. Prepare NOW—stock Garco Gaskette Roll today.

NEVER before have you been able to buy high grade, wire inserted asbestos sheet packing in convenient, ready-to-use form like this. Never before have you been able to get it, cut 10″ wide by 40″ long—ready for the dozens of jobs where this size just fills the bill.

Now you can keep in stock just the quantity you need—know that it is fully protected from dust and dirt—know that you are prepared for every emergency.

GARCO GASKETTE ROLL is the newest, biggest item in the complete line of highest quality GARCO Asbestos Products. It is made of high-grade, long-fibre asbestos, thoroughly re-inforced by an interwoven net-work of strong, fine wire. It is treated with GARCO Special Waterproofing Compound—finished red one side, graphite the other. Gaskets made from Gaskette Roll are guaranteed for the highest pressure or temperature ever met in steam or gas engine service.

Make up your mind now to stock GARCO GASKETTE ROLL. Ask your jobber for prices or write us direct for full information.

The same high-grade Garco Sheet Packing also sold under GARCOBESTOS Brand in full rolls of 250 pounds and half rolls of 125 pounds, 40″ wide, all standard thicknesses.

GARCO
ASBESTOS PRODUCTS

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Locomotive Throttle and Air Pump Packings
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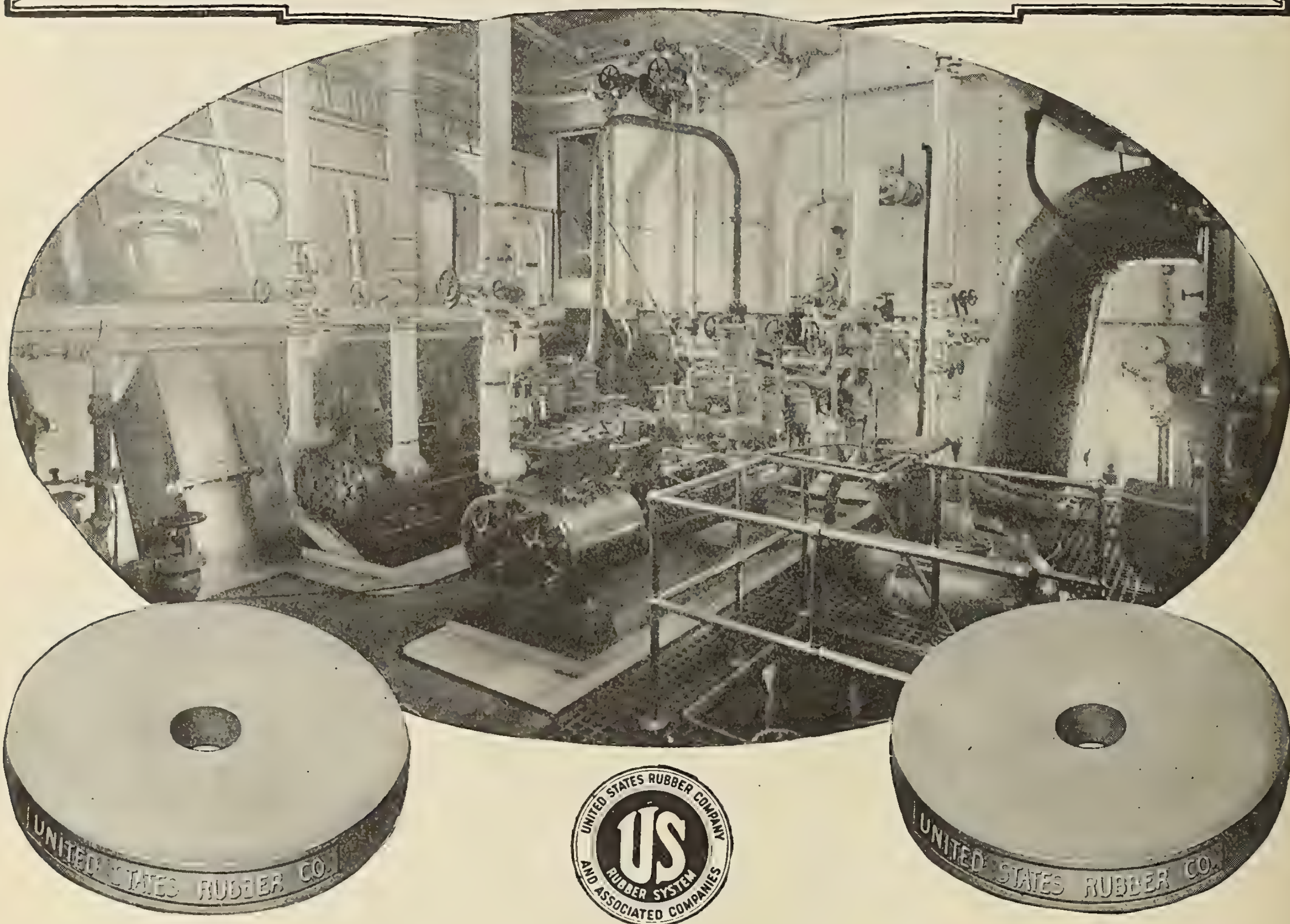
GARCO

ASBESTOS PRODUCTS—BRAKE LINING—PACKINGS—TEXTILES

United States Rubber Pump Valves



The Right Valves for Any Pump

The exacting requirements of marine service demand the use of rubber pump valves especially designed for the work they must perform. Upon the valves depends largely the efficiency of the pump.

Marine Engineers will find it advantageous to specify United States Pump Valves for service on Hot Water Boiler Feed, Condenser and Air, Fire and Bilge Pumps, etc.

Consult our Engineering Department in regard to the conditions the valves are required to meet. This service is free. There is a United States Pump Valve to meet every condition of service.

United States Rubber Company

COUNTERSINKS
FOR
SHIP PLATES

USED IN THE LARGEST AND BEST SHIPYARDS AND NAVY YARDS

HIGH SPEED

BEST
FOR THE
PURPOSE

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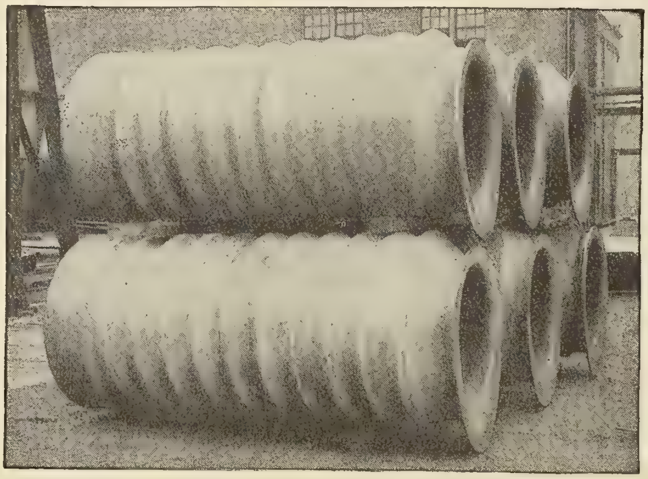
Japan, The F. W. Horne Company, Tokyo.
Spain and Portugal, American Machinery Syndicate, Barcelona, Madrid and Lisbon.

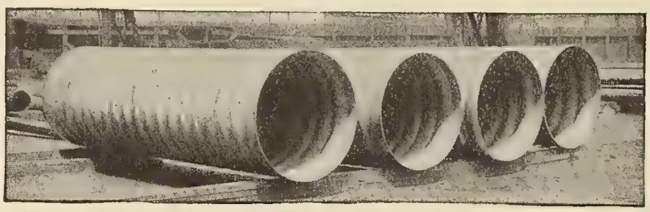
CORRUGATED FURNACES



FOR

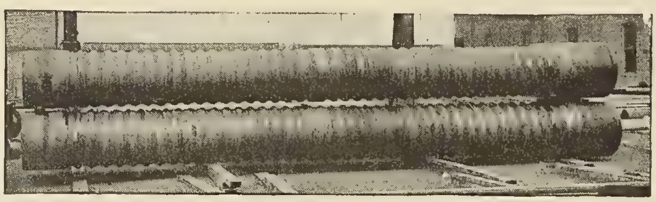
Internally Fired Boilers
Scotch Marine Boilers
Oil Stills, Etc.

Made from highest quality firebox steel in accordance with Lloyd's or U. S. Government requirements.

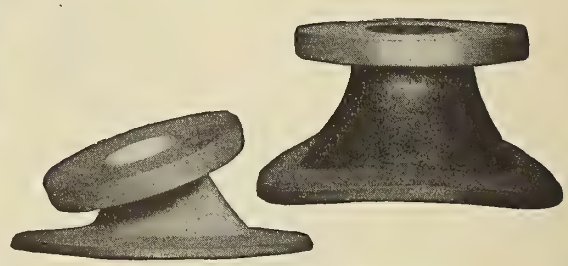


LAP WELDED DRUMS and FLUES, FORGED STEEL BOILER FLANGES, FORGED STEEL FLANGES For High Pressure Steam Mains and Riveted Pipe.

Stock for Prompt Shipments



TAYLOR SEAMLESS FORGED STEEL BOILER NOZZLE



Sizes 1½″ ta 8″ inclusive.

One piece forging solid steel without weld. Make the Boiler wrought steel throughout. Needless delays are eliminated by its use.

Spiral Riveted Pipe, Lap Welded Pipe Exhaust Steam and Hydraulic Supplies.

Catalog mailed upon request.

MANUFACTURED BY **AMERICAN SPIRAL PIPE WORKS**

New York Office: 50 CHURCH STREET Main Office and Works: CHICAGO (P. O. BOX 485)

DIAMOND SOOT BLOWERS ON FOSTER MARINE WATER TUBE BOILERS

"I'LL SAY THEY DO!"

declared Warner, the Fleet Engineer to Captain Richmond, the "Old Man."

The two were in warm argument over the trip log of the S. S. Arethusa, the document having, as readers of this paper will remember the Chief Engineer predicted, caused them to "sit up and take notice."

"Now let me get this straight." The veteran vessel owner replied. "We own the Arethusa four years. The best speed she is able to maintain is an average of eleven knots, which is a trifle faster than either of her sister ships is able to make, due probably to the fact that MacGregor is the better engineer. Then, all of a sudden, we find her arriving in port eighteen hours ahead of schedule. Her log shows she has been making nearly twelve knots an hour and when I ask you for an explanation, you answer that you have equipped her boilers with Diamond Soot Blowers! That right?"

The Fleet Engineer nodded.

"Now Mr. Warner," the Captain continued with asperity "Will you kindly tell me what effect a device for blowing the soot out of a boiler has on a vessel's speed?" His disbelief was evident.

"The result is simply explained." Warner smiled. "First your soot is not merely blown out of the boilers. It is blown off the fire surfaces where its presence prevents heat transference. The less resistance there is to the entrance of the heat units into the water in the boiler, the easier it is to make steam. The more steam, the more work from the engines. In this instance the Arethusa not only made a quicker voyage, but she burned five per cent less fuel than usual!" He finished.

"Then your soot blowers increase operating efficiency all down the line, from reducing overhead per ton in the office, to increasing tonnage handled per year, and so on clear down to a saving of several thousand dollars in fuel?" The Captain demanded.

"I'll say they do!" Warner repeated.

"Hmm! The Old Man's fingers drummed the table for a long minute. He was doing some rapid thinking. "Mr. Warner," he announced finally, "I don't know whether to fire you or raise your salary. Man and boy you have been with the Red Star Navigation Company eighteen years. You know our policy regarding increasing operating efficiencies by all practical means and methods and I should like to have you tell me why I ought not to discharge you for not putting in Diamond Soot Blowers on all our boats years ago." He paused a moment and the smile which made his men swear by him began to light his face. "On the other hand, Frank, I admit that a great deal of our present efficiency is due to your suggestions and the improvements which you have inaugurated so I guess I'll have to give you a raise provided you have all our boats equipped within 90 days."

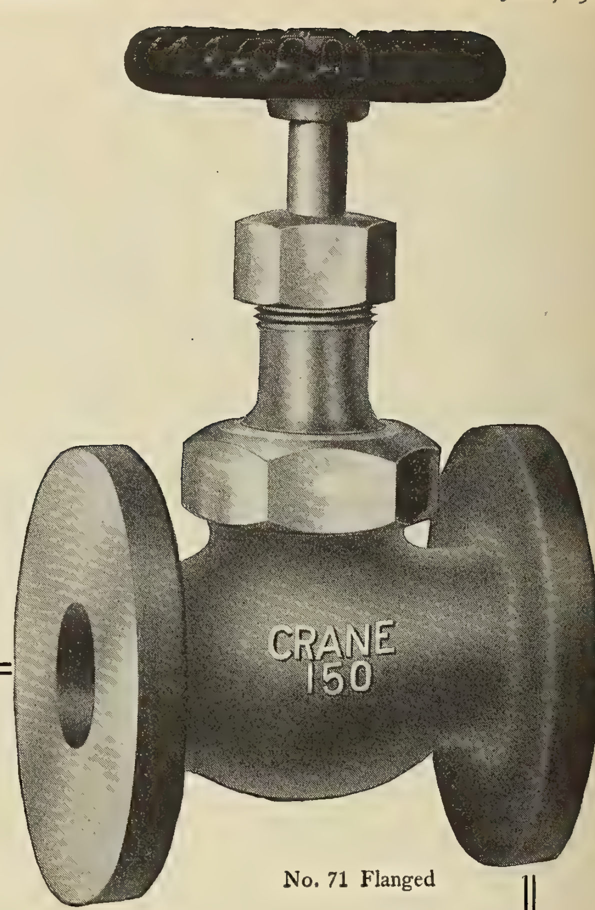
Important Notice to Marine Men: For further information on Diamond Soot Blowers ask for Bulletin 122 "HOW SOME SHIP-OWNERS HAVE INCREASED THEIR PROFITS."

DIAMOND POWER SPECIALTY COMPANY
Detroit, Michigan

Diamond

SOOT BLOWERS—SAVE 4 to 8% FUEL

CRANE



No. 71 Flanged


BRUBAKER
Just a "Tap" But
A "Just Tap"
You'll know that by
the number of holes
it taps per tap
THE TAP WITH THE
"CONTINUOUS TAPER"
A METHOD BY WHICH YOU CAN'T TELL WHERE THE TAPER THREAD ENTERS THE STRAIGHT THREAD, THEREBY PRODUCING A UNIFORM CUTTING EDGE WHICH DISTRIBUTES THE WORK.
W. L. Brubaker & Bros.
50 Church Street, New York

The "MaxiTap"

PATENTED

Machine Relieved Thread

The Machine Relieved Thread of the "MaxiTap" materially increases its already remarkable efficiency by eliminating friction to a large extent.

Each tooth of the "MaxiTap" is backed off like a milling cutter, thus reducing the drag of the heel and walls of the thread, which otherwise would generate a great amount of heat, rendering lubrication difficult and retarding the tap.

Yet the "MaxiTap" may be sharpened repeatedly without effecting its size, as each tooth is left concentric for a certain distance back of the cutting edge.

TRADE MARK REG. U.S. PAT. OFF.

GTD

For more holes, and better use the "MaxiTap"

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Greenfield, Massachusetts, U.S.A.

World's Largest Manufacturers of Screw Cutting Tools

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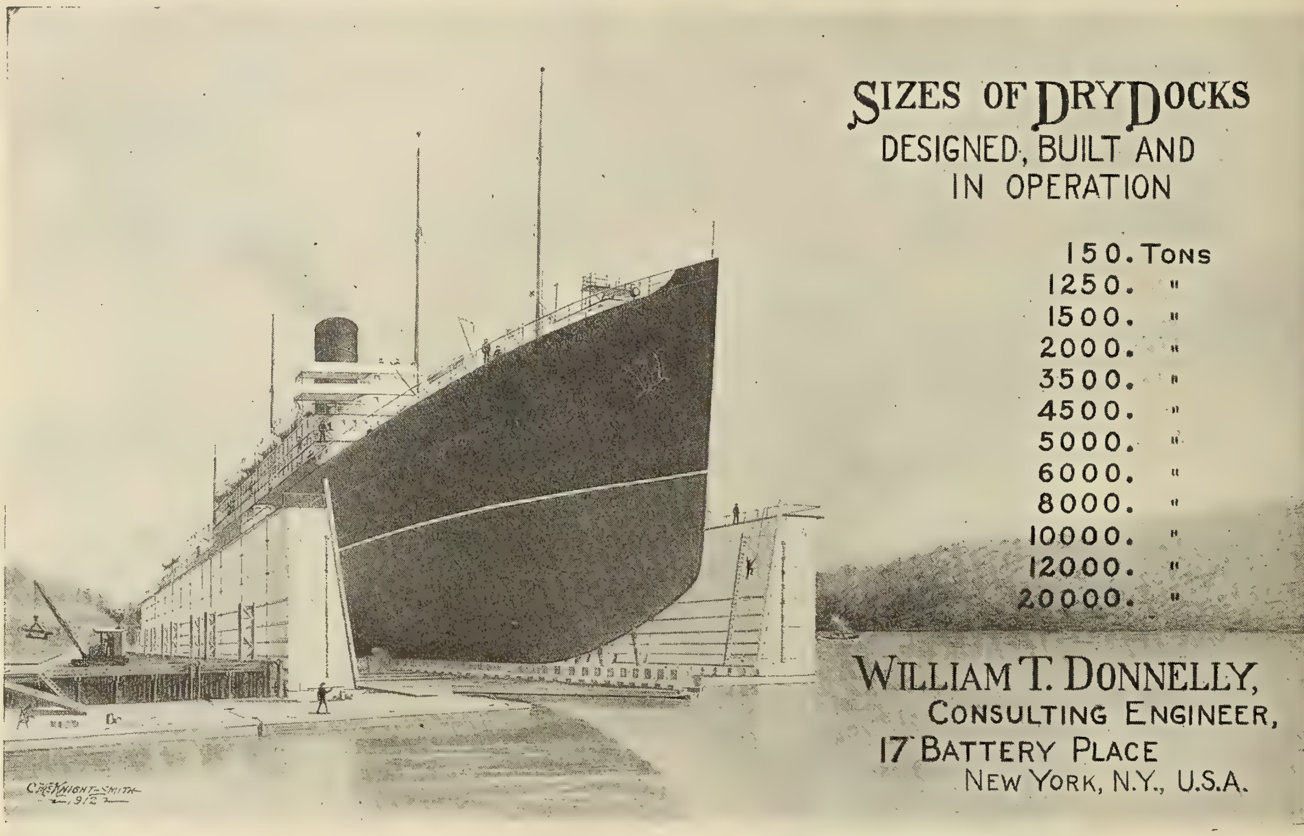
SIZES OF DRY DOCKS
DESIGNED, BUILT AND
IN OPERATION
150. TONS
1250. "
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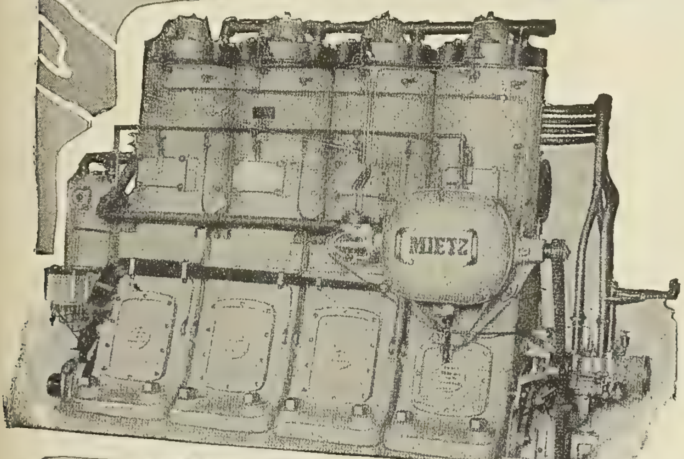
CONSULTING ENGINEER,
17 BATTERY PLACE
NEW YORK, N.Y., U.S.A.

FOR FUEL ECONOMY

BUY W.S.S.

A saving of 40% is accomplished under actual service conditions, not manufacturers' test. The pioneer of this type operating on low grade fuels exclusively. Does not use any of the high pressures and is free from the use of complicated auxiliaries and does away entirely with Electric Ignition devices, carburetors, valves, etc. Built in sizes from 40 to 350 H. P. in both reversing gear and direct reversible types.

MIETZ OIL ENGINE



Gives a maximum of Simplicity, Reliability, Durability and Economy in every respect. Used by the United States Government, Foreign Governments and the Merchant Marines of the World.

We also build Stationary Engines for all power purposes.

Send for data, stating your requirements.

AUGUST MIETZ CORPORATION

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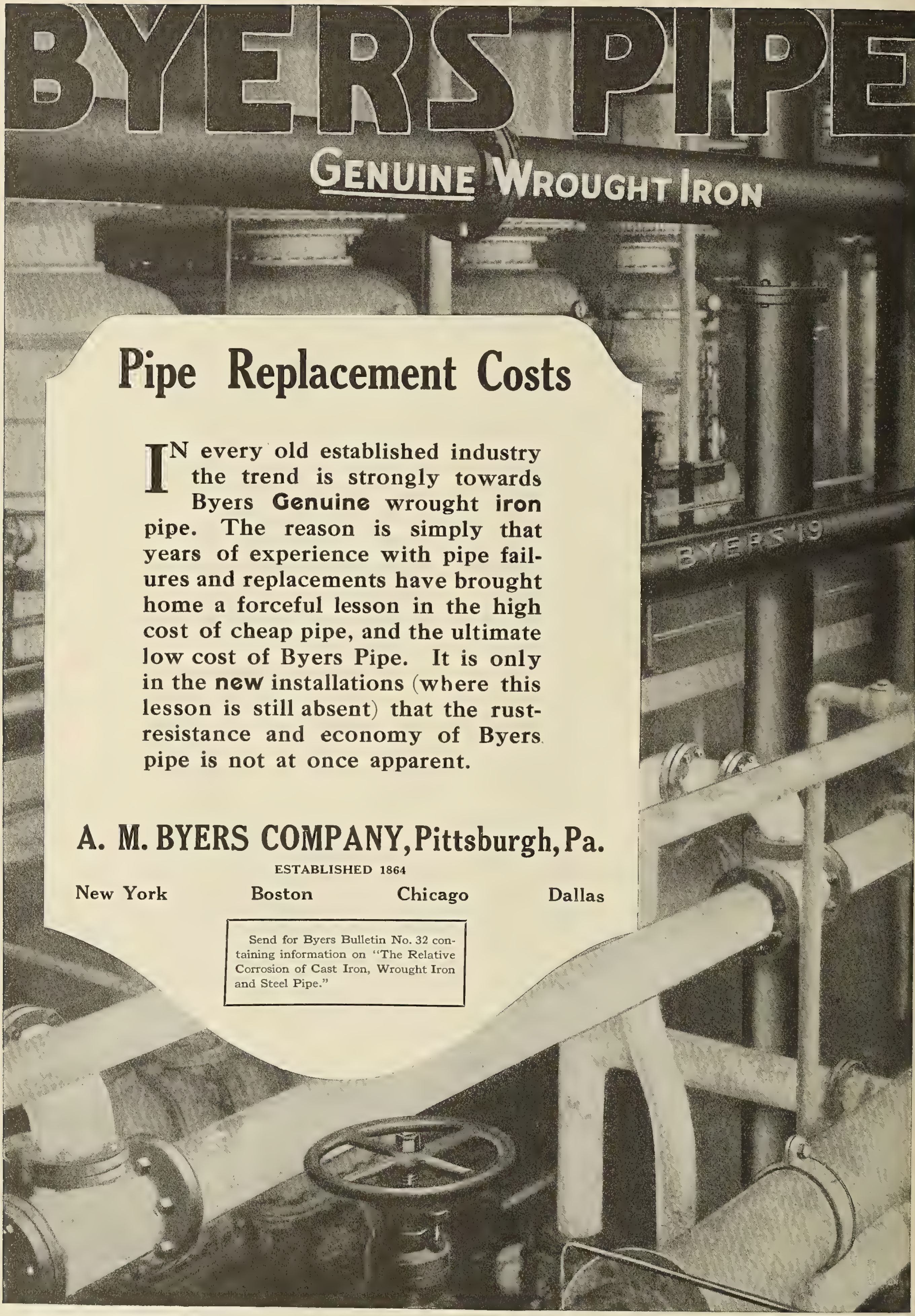
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GENUINE WROUGHT IRON
Pipe Replacement Costs
IN every old established industry the trend is strongly towards Byers Genuine wrought iron pipe. The reason is simply that years of experience with pipe failures and replacements have brought home a forceful lesson in the high cost of cheap pipe, and the ultimate low cost of Byers Pipe. It is only in the new installations (where this lesson is still absent) that the rust-resistance and economy of Byers pipe is not at once apparent.
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ESTABLISHED 1864
New York Boston Chicago Dallas
Send for Byers Bulletin No. 32 containing information on "The Relative Corrosion of Cast Iron, Wrought Iron and Steel Pipe."
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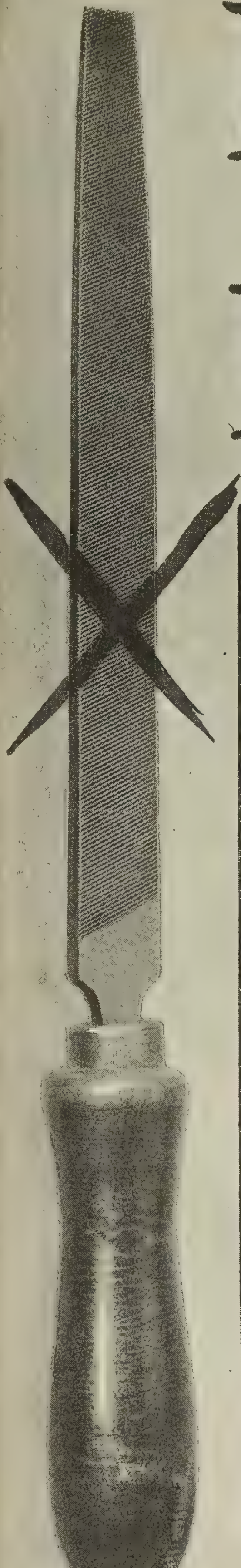
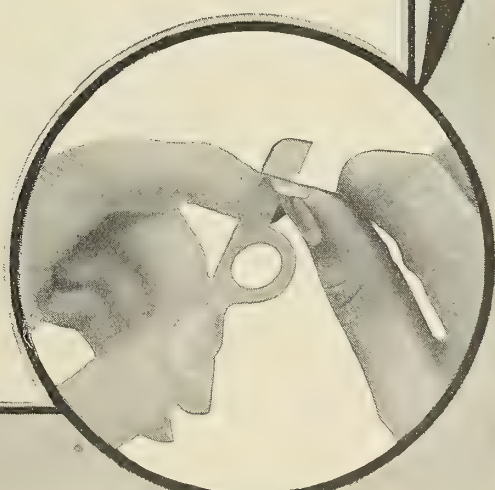
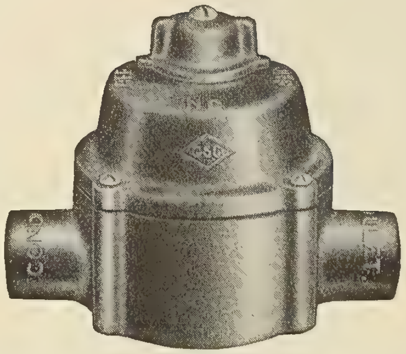




Complete Protection *for* SNAP SWITCHES



Type GSC Condulet

"Here's another new Condulet — Type GSC. It's a dandy and lets me use a snap switch on this outdoor installation.

"No dust or moisture can get inside the Condulet and the thumb knob can't be broken off. The indicating feature is preserved, too."

Type GSC is only one of a complete series of protective Condulets for snap switches. They are especially suited to out-of-door, marine, garage, refinery, and textile and flour mill installations.

Write for new Condulet Bulletin No. 1000-I
You will find it valuable

CROUSE-HINDS COMPANY

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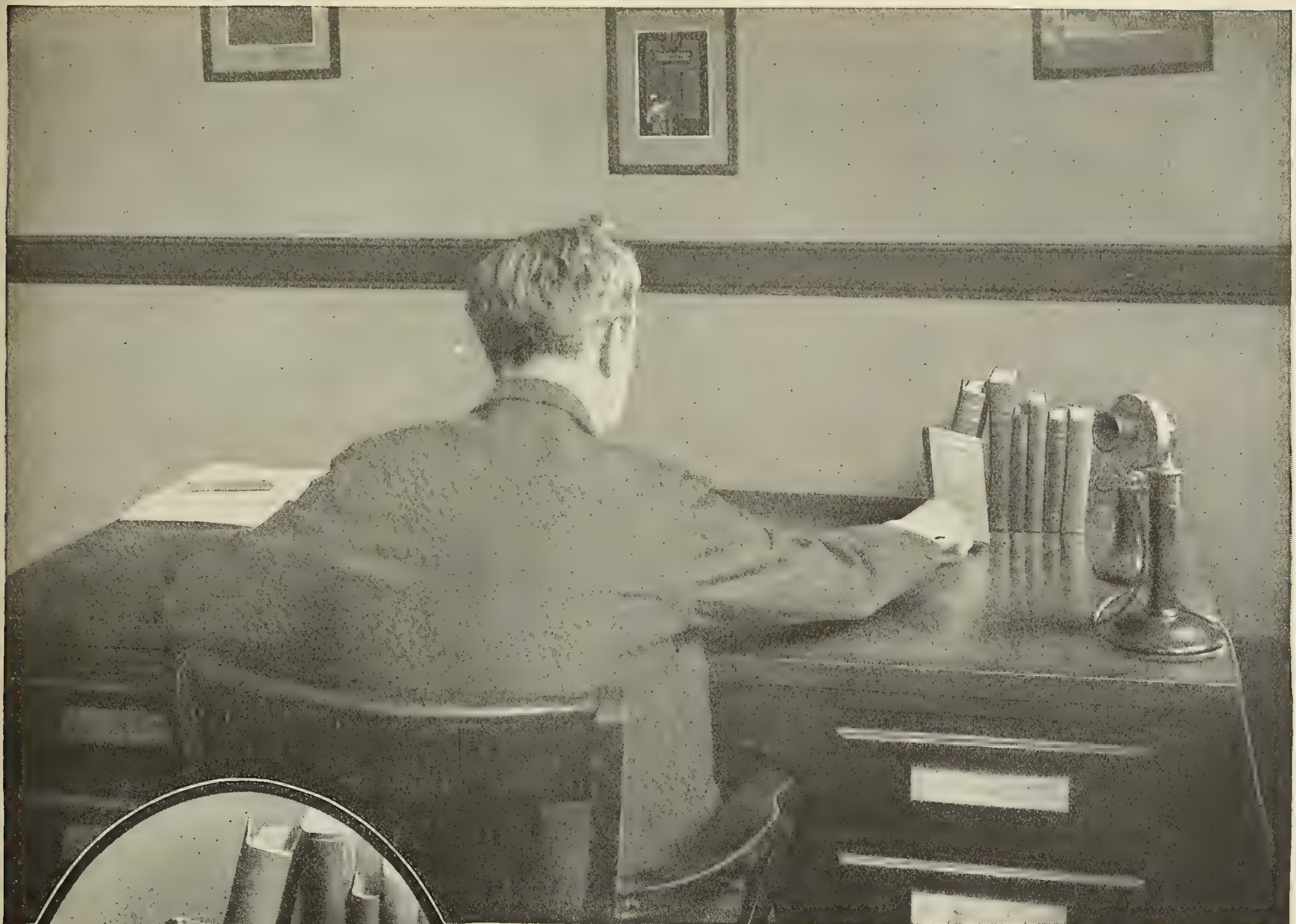
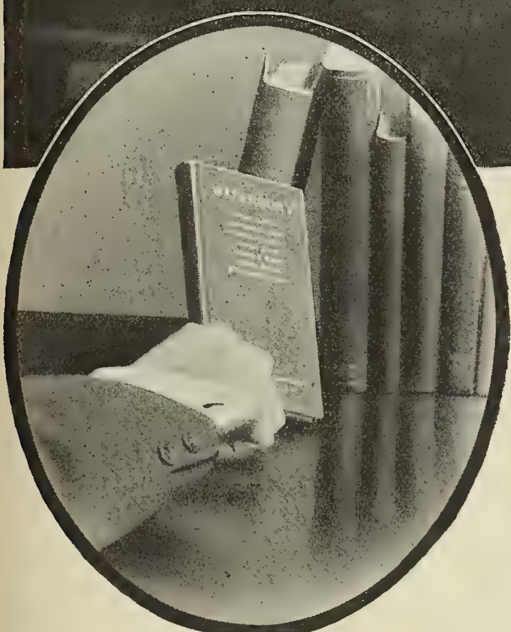
NEW YORK BOSTON CHICAGO





When it's a question of rope— I reach for the waterbury catalog

It is much more than a catalog, as you usually think of that word. It's really a Rope Handbook. There isn't anything you need to know about rope that isn't in it, in concise, "quick-findable" form. It takes the place of a half-dozen books—and more than that, it has some information in it you can't find anywhere else.

Of course, it treats of Waterbury rope, because rope facts are facts for every **good** rope. And Waterbury rope has the quality in it—quality of material, quality of workmanship.

You'd expect to have to buy this Rope Manual—and you'd find it well worth a price, at that—but it doesn't cost you anything but the postage stamp on your letter. A copy is free for the asking.

Write for yours today—and when it comes, put it where it's easy to reach. You will find it useful. Just address the

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OUTWARD BOUND

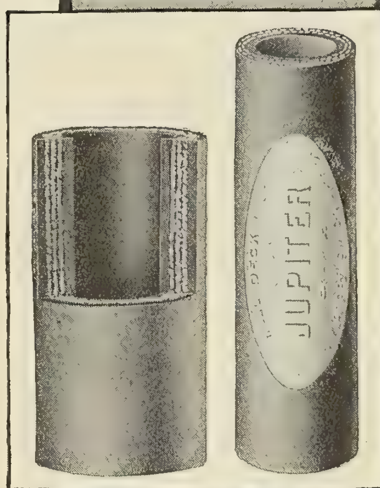
After coaling—and for all general washing purposes, no hose will make things ship-shape in quicker time than Goodrich Marine Hose.

It's kink-free. Stands abuse. Is very flexible, easy to handle, and its unusually long life spells economy in every foot of it. Furnished in wrapped type, 50-foot lengths. Braided type, 500-foot lengths.

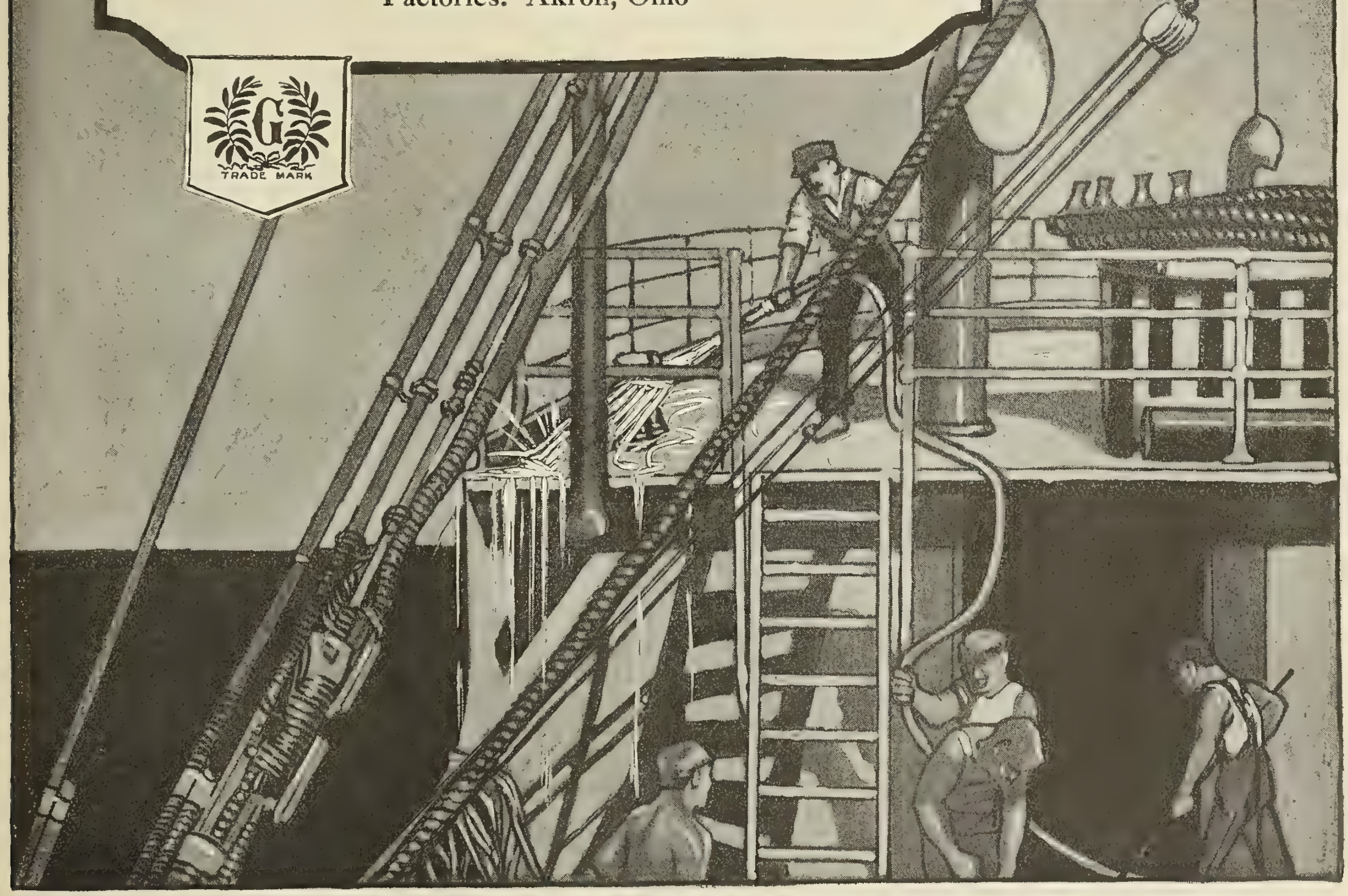
Goodrich makes Hose for all Marine purposes. Your needs will be taken care of by men who understand the kind of supplies you want. Requests for samples and prices put you under no obligation.

THE B. F. GOODRICH RUBBER CO.

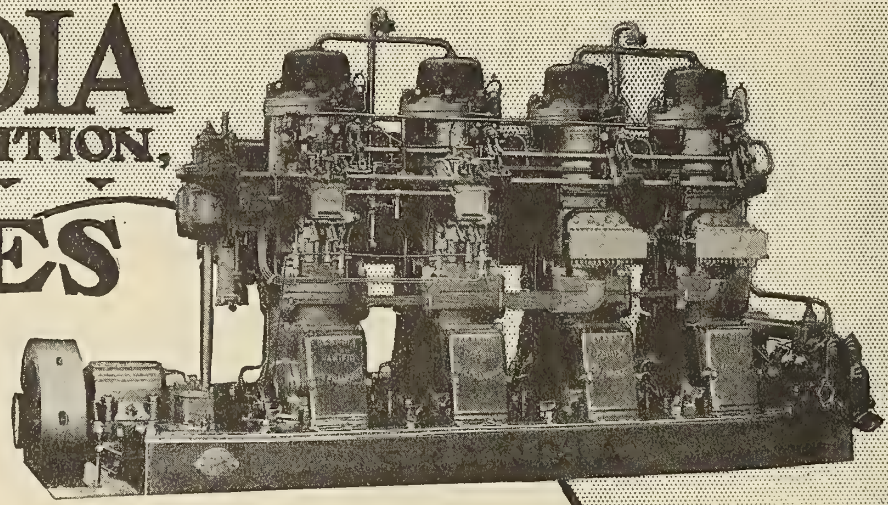
Factories: Akron, Ohio



TRADE MARK



SKANDIA SURFACE IGNITION, HEAVY OIL ENGINES



SKANDIA ENGINES are built in standard sizes from 5 to 500 H. P. They are the logical engine for moderate speed vessels. They are economical, reliable, and run on low fuel consumption.

WERKSPOOR DIESEL ENGINES represent the most modern type of Diesel Engine, embodying every refinement. Engines of the 4-cycle type built from 340 H. P. and up. All engines built in U. S. A.

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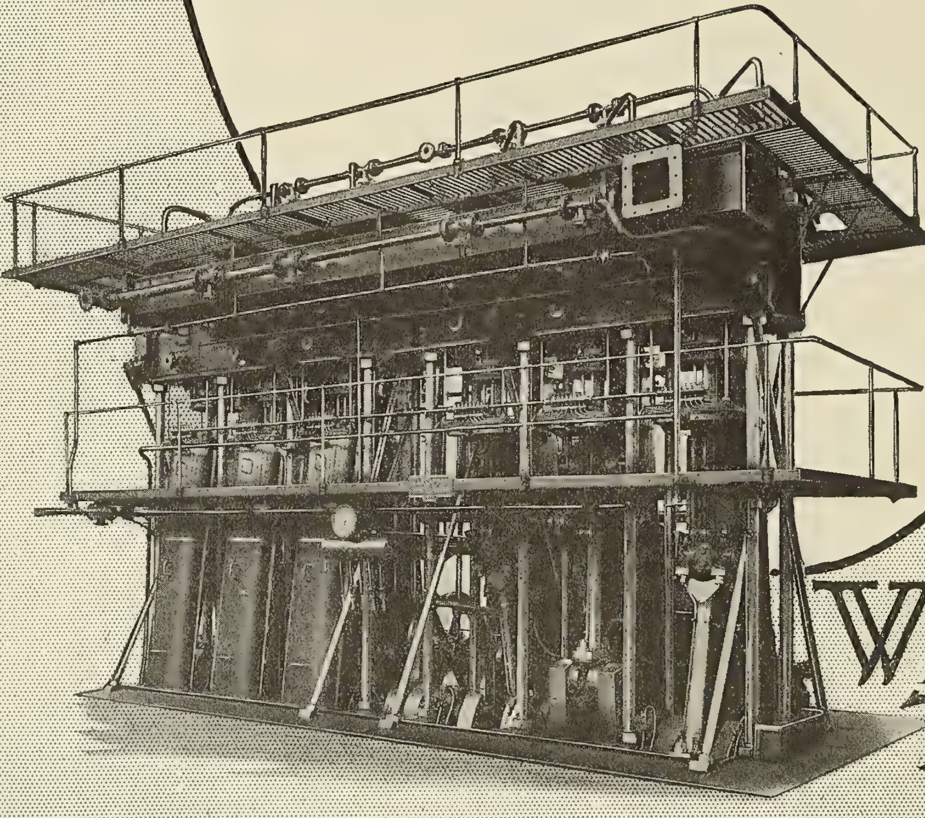
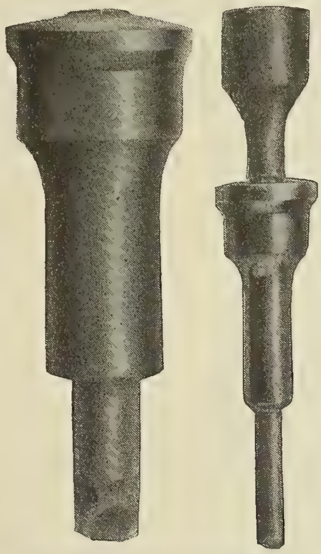
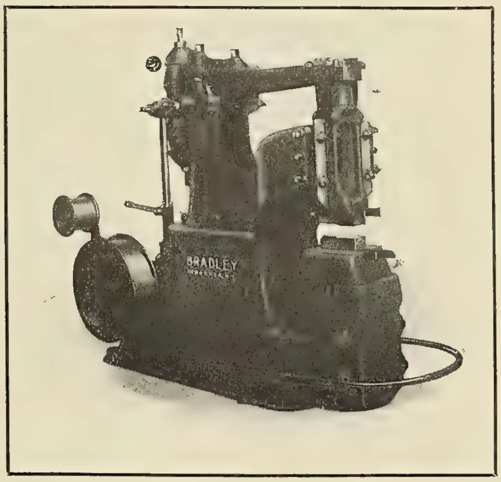


WERKSPOOR TRUE DIESEL ENGINES

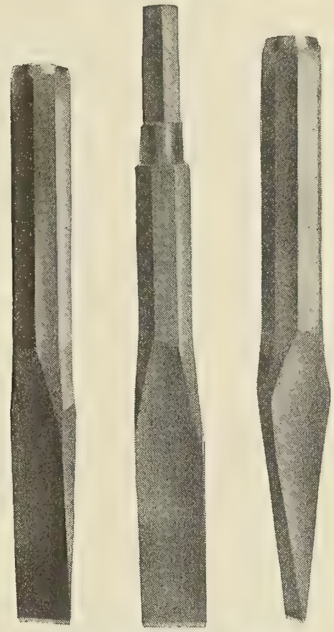
BRADLEY HAMMERS



Some of the tools made with The Bradley Hammer



THE HAMMER



Some of the tools made with The Bradley Hammer

YOU SHIPBUILDERS

Did you ever stop to think that with a Bradley Hammer, a good man and proper dies you could make all your own punches and chisels right off the bar in your own plant and at the minimum of expense?

Surest thing you know. These illustrations were taken from photographs of the actual articles thus made. The smaller punches can be made at the rate of probably 100 per hour and the larger ones at the rate of 80 per hour and to 0.010″ perfect at that. More accuracy, less quantity. A "hammered" punch will beat a turned punch to death. The "waste" of stock is practically confined to short bar ends, as the excess of metal from one punch goes into the next punch. You will have no "turnings" for the scrap heap. Just cut off the punches under the Hammer, grind cutting edge and temper. Simple, isn't it? Cold chisels both hand, and for pneumatic hammers made under the Bradley at the rate of 80 per hour. Just cut off, grind cutting edge and temper. Bradley Hammers are rarely idle unless you have less work than they can do. Our more than 45-years' experience in making Bradley Hammers is at your service.

C. C. BRADLEY & SON, Inc.

Established in 1832

SYRACUSE

FOREIGN AGENTS: Brazil, France, Belgium, Italy, Switzerland, Spain and Portugal; Fenwick Freres & Co., 8 Rue de Rocroy, Paris. England, Buck & Hickman, Ltd., London.

NEW YORK

CAMOUFLAGE!

Camouflage in war saved lives, money and material. But camouflage in packing is cheap for the maker and costly for the user. A little red coloring doesn't make packing—but it may cover a multitude of sins.

VULCABESTON

Red Fibre Sheet Packing

is honest packing—all the way through. It is made from long-fibre asbestos by a special process which gives it unusual resiliency and pliability. Unlike rubber it will not squeeze out or stretch.

On shipboard, in power plants and refrigeration plants, in chemical factories, or on locomotives — wherever a gasket is used — Vulcabeston will insure dependability. It is "the universal packing"—serving everywhere, regardless of temperature or pressure, corrosion or moisture.

"Vulcabestonize" *your* packing problems.

If your regular dealer cannot supply you, write us direct

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VULCABESTON

Train Load of Upright Marine Pumps Leaving Dean Bros. Factory

Record Ships from Coast to Coast

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DEAN BROS. STEAM PUMP WORKS. INDIANAPOLIS.
NOT IN THE PUMP TRUST.


Westinghouse
Marine Propulsion Equipment
Helping To Bring The Boys Home
This U.S. Transport is equipped
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Propulsion Machinery—
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SUCCESSORS TO
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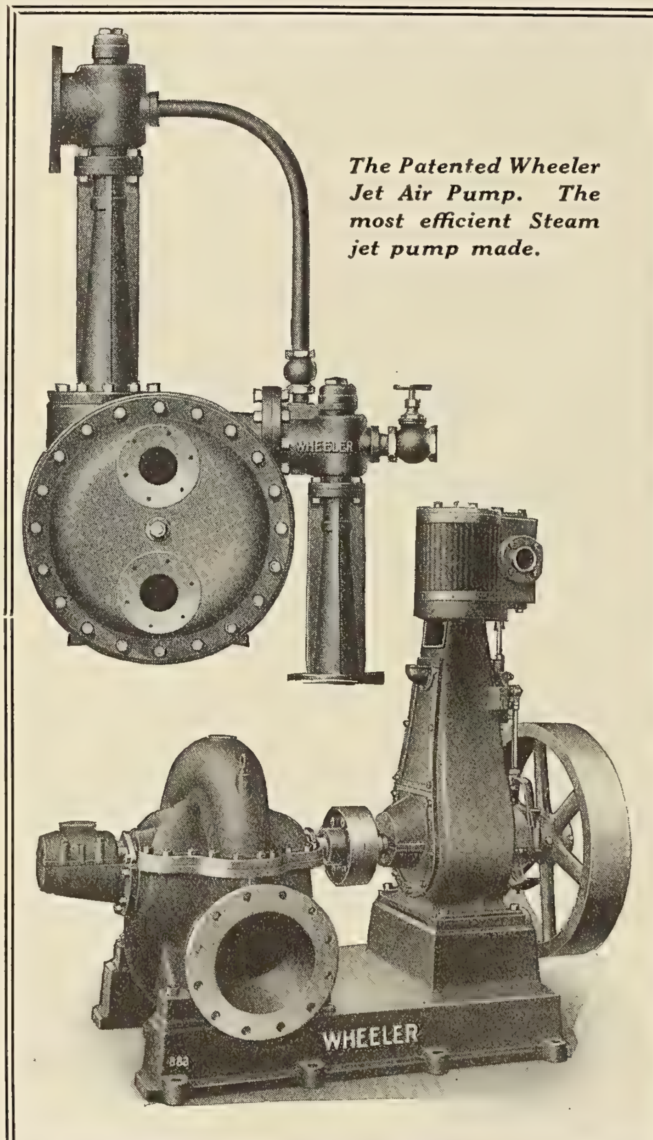
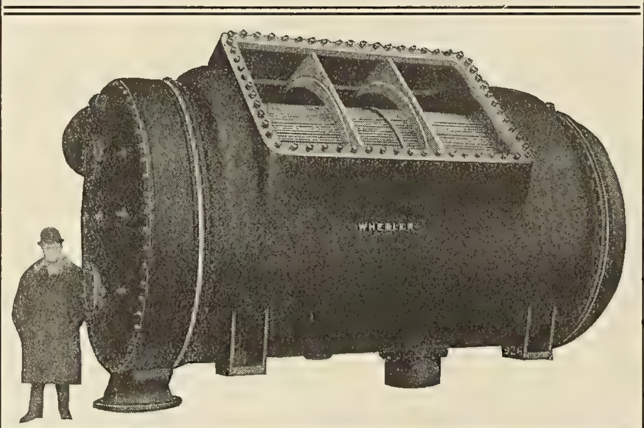
MARINE EQUIPMENT

WHICH BULLETIN DO YOU WANT?



The Patented Wheeler Jet Air Pump. The most efficient Steam jet pump made.



Make a mark in the square opposite the equipment in which you are interested, give us your name and address, and tear out and return this advertisement to us. We will gladly send one or all bulletins to responsible persons.

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Marine Lighting and Signaling Apparatus
The Nerves of Navigation
The working efficiency of a ship depends largely on quick control through its signaling system.
Like the nerves of the human system, the messengers to the brain—so the signal system of a ship must respond instantly and accurately to the will of its master.
Action—instant, efficient action—at the press of a button under *all* conditions, in fair or foul weather, is the result of sturdy Benjamin Marine Signaling Equipment.
The severest tests of marine engineers and builders have proved the worthiness of Benjamin marine lighting as well as signaling apparatus. Our new marine catalog gives all the facts and figures. Write for a copy today.
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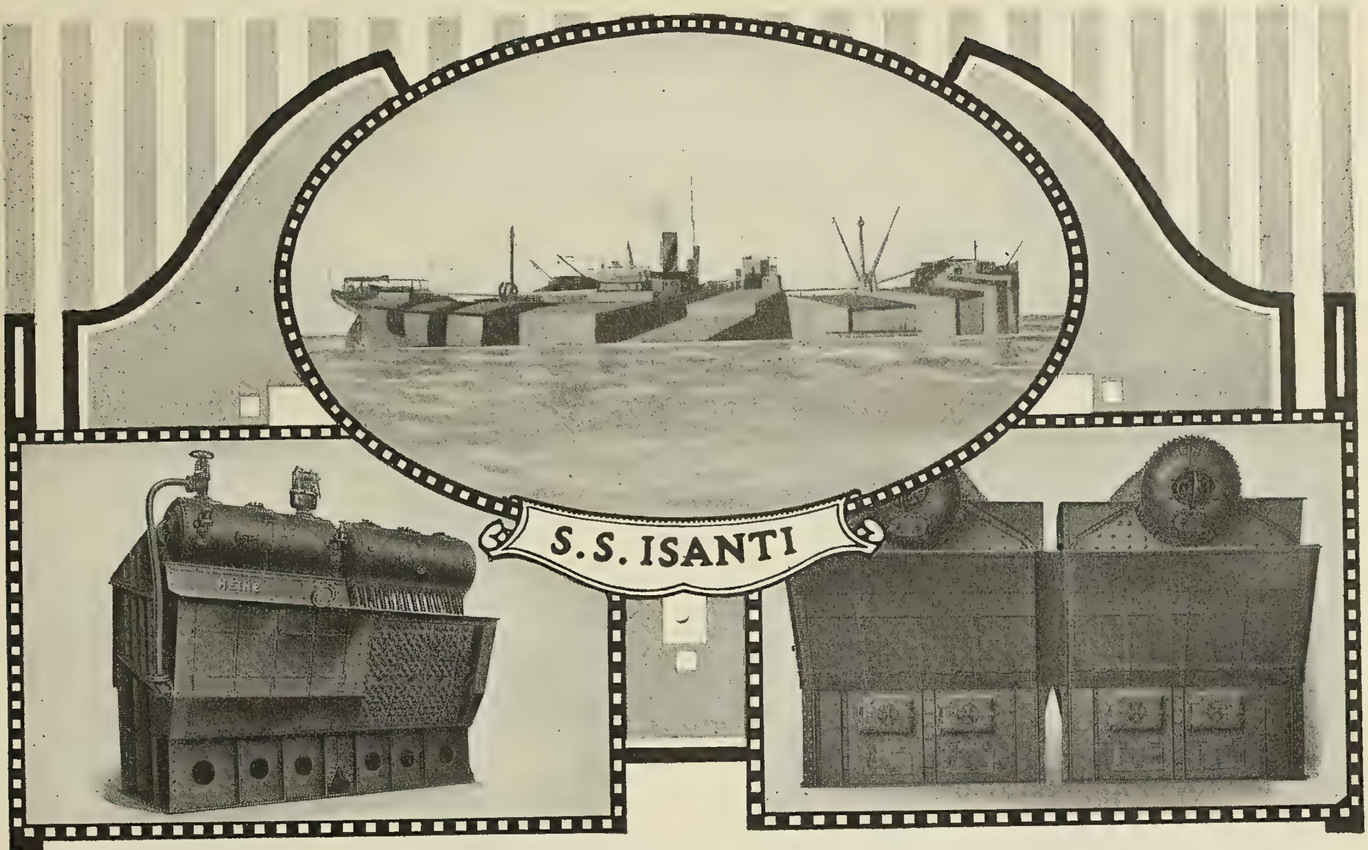

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Without obligating me in any way you may place my name on your marine mailing list.

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SOCONY No. 62—STANDARD OIL COMPANY'S TANKER
197 ft. x 36 ft. x 14 ft. 4 in. 1600 D.W. Tons Equipt with One 320 B.H.P. BOLINDERS OIL ENGINE. Speed, 7½ knots.

Bolinders Engines make ideal power plants for Oil Barges and Tankers. Their compactness, light weight, extreme dependability make them by far the most efficient propulsive power for boats of this type.

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For work where ductility and high tensile strength is required.

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This is an exceptionally easy and fast flowing electrode and lays relatively flat where deposited; of medium tensile strength; specially designed for welding thin cast iron.

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High tensile strength and conductivity combined with very smooth flowing; specially designed for overhead welding with deep penetration.

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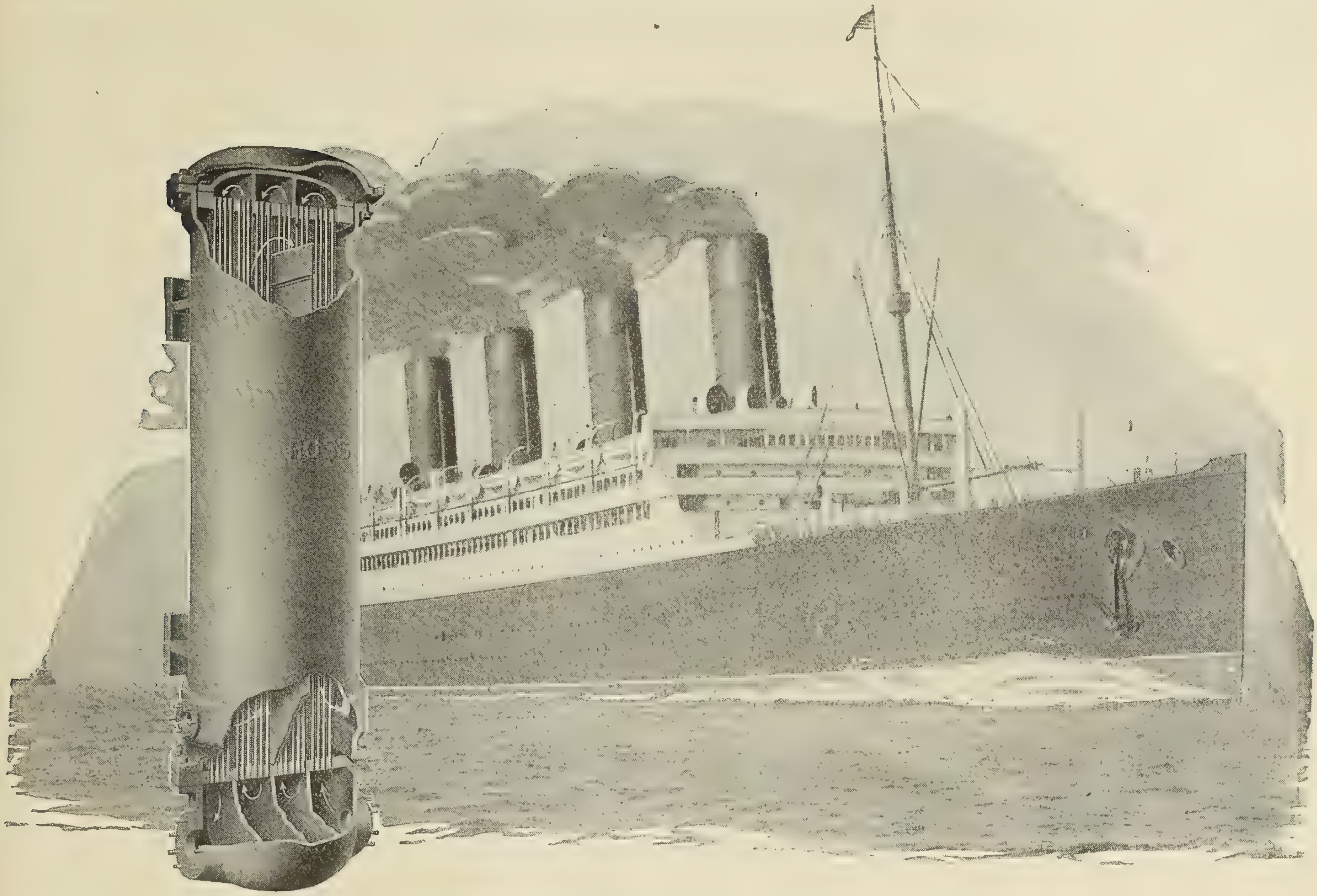

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do yeoman duty on the best boats

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The high speed turbine brought additional speed and more dependable propelling power. But in this kind of installation a large quantity of oil had to be circulated over the bearings and around the gears.

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Surface Barometric and Jet Condensing Equipments for Power Plants.

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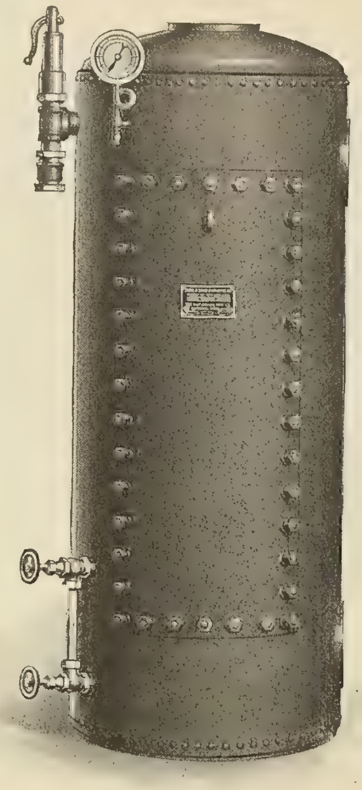

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Fast Passenger and Commercial Steamers, Shallow Draught Vessels, Tugs, &c.,

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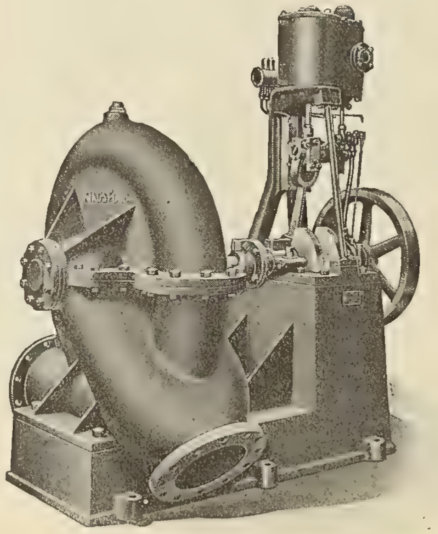

FIGURE 202

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are in use in all classes of Government and Merchant ships, as they have proven dependable units. We can meet your specifications.

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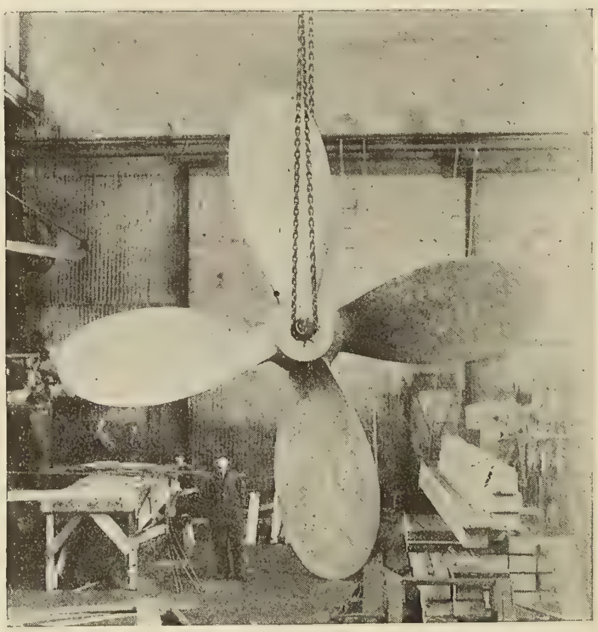

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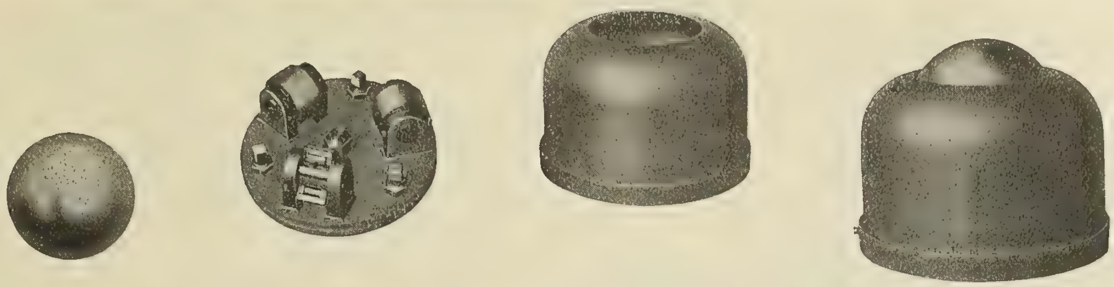
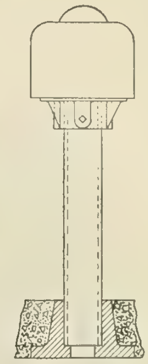

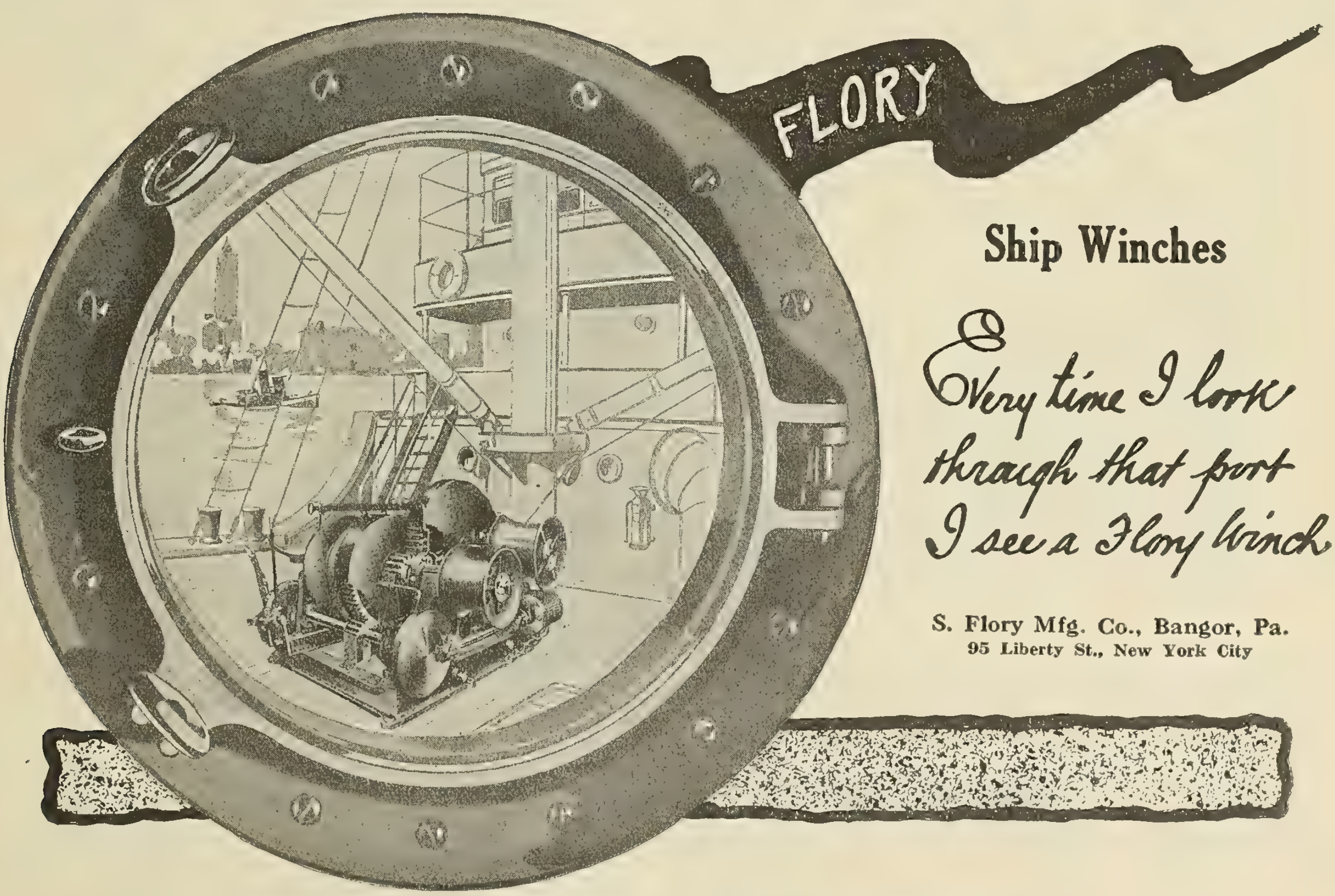
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Ship Winches
Every time I look
through that port
I see a Flory Winch
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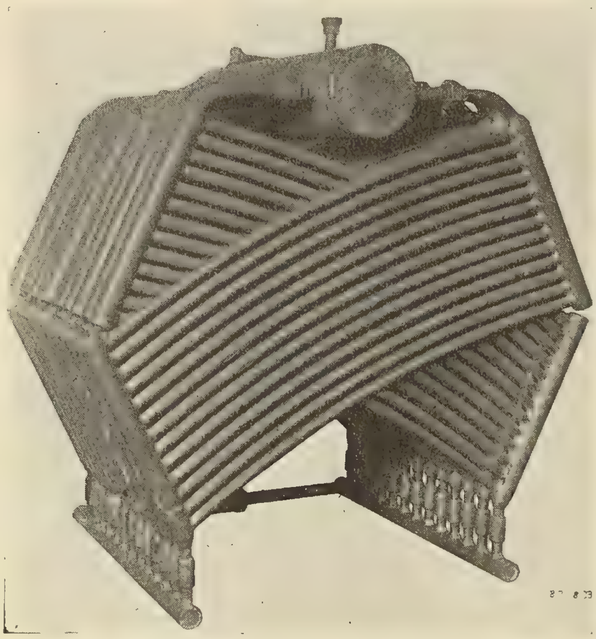
TORCHWELD TORCHES
use both gases under evenly balanced pressures—non-flash construction.



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TORCHWELD TORCHES make sure, dependable, leak free joints.

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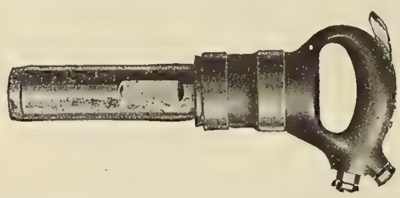
New Cleveland Pocket-in-Head Riveter

New Cleveland Pocket-in-Head Riveter

NEW CLEVELAND "POCKET-IN-HEAD" RIVETING HAMMER
MOST POWERFUL RIVETING HAMMER ON THE MARKET

The New Cleveland is shorter over all. Hits a harder blow, and uses less aid than any hammer made.



The New Cleveland has a higher speed with less recoil in operation than any riveter on the market.

We can prove it in your work

THE NEW CLEVELAND is made in 15 sizes with Outside or Inside Latch, and is adapted to all classes of work upon which Riveting Hammers can be used.

THE NEW CLEVELAND has a driving range in rivets from ¼-inch to 1½-inches, and is especially adapted for Shipbuilding, Boiler Construction or any riveting where speed and power are required.

IN STOCK: Riveting Hammers, Chipping Hammers, Air Drills for Reaming and Tapping, Breast Drills, Corner Drills, Portable Air Grinders in two sizes, Oscillating Valve Grinders, etc.

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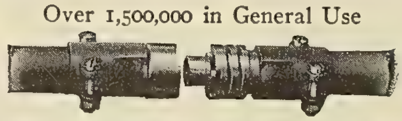
Over 1,500,000 in General Use

Air-tight under all pressures.
Quickly connected or disconnected.



Shows Cleco Never-Slip Hose Clamps Attached to Bowes Coupling

Interchangeable in all sizes from ¼-inch to ¾-inch inclusive.

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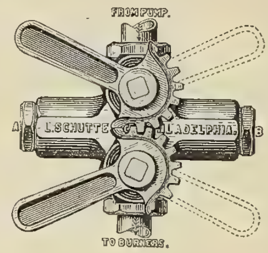
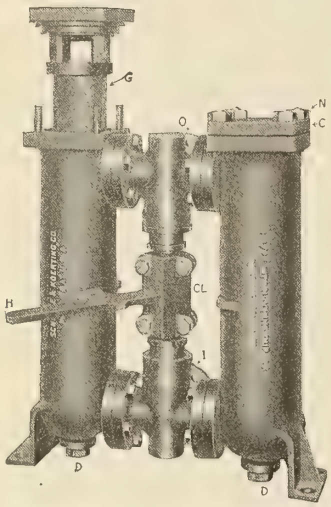
New Cleveland Pocket-in-Head Riveter

DUPLEX SHIP STRAINERS

WITH INTERLOCKING COCKS, INSURING A CONTINUOUS FLOW OF STRAINED OIL AT ALL TIMES.

MADE TO MEET OIL MARINE REQUIREMENTS. USED ON SUCTION AND DISCHARGE LINES OF FUEL AND LUBRICATING OILS.





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given by Skinner Eddy Shipbuilding Corporation for these Sprague Electric Hoists are evidence of satisfactory service.

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OF GENERAL ELECTRIC COMPANY

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LIFE BOAT DEPT.

16-20-24-26-28 Feet. Metallic steel keel Life Boats built to Emergency Fleet Corporation plans and specifications.

Other sizes on special order.

Capacity, Ten complete boats per day.

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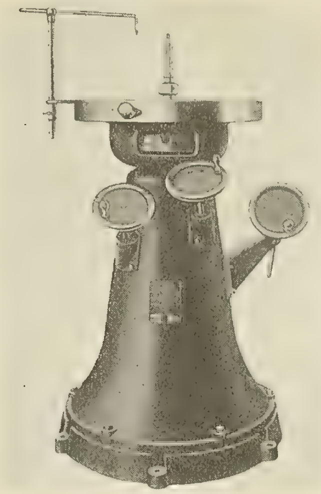

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FOR THE SOLUTION OF ALL VIBRATION TROUBLES AS FOUND IN

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THIS MACHINE WILL SHOW THE EXACT AMOUNT OF THE COUNTER-WEIGHT REQUIRED AND THE EXACT CIRCUMFERENCE PLANE WHERE THE COUNTER-WEIGHT SHOULD BE TAKEN OFF OR ADDED ON

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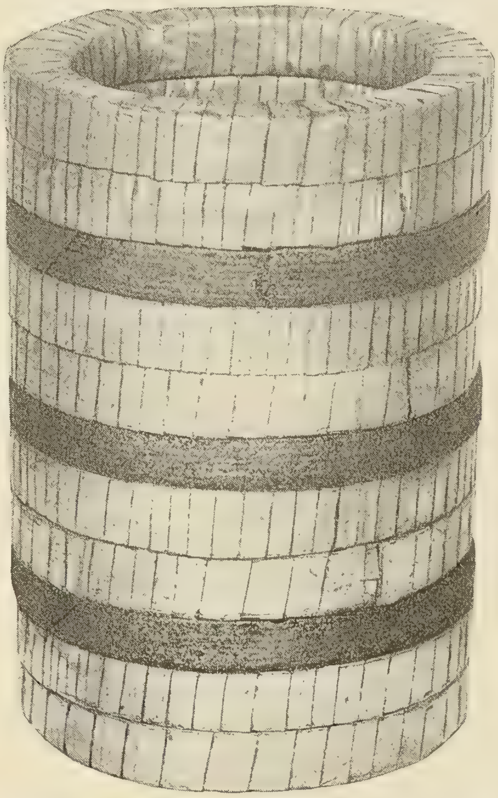
"JOHN CRANE"
Flexible Metallic Packing
For Marine
Refrigerating Machines



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MARINE ENGINEERS will find "JOHN CRANE" a perfect packing for all kinds of refrigerating machines because it is dependable and permanent. No shutting down to repack—no scoring of rods—no leakage—no troubles of any kind. "JOHN CRANE" is always flexible, compressible, and as frictionless as a babbitt bearing.

"JOHN CRANE" packs any service—ammonia, carbon dioxide, air; and all types of machines—reciprocating or rotary, single or double-acting compressor.

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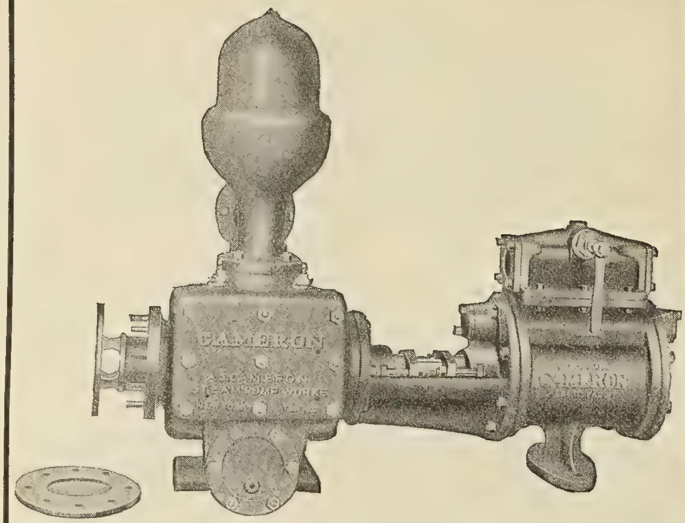

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Testimony regarding Cameron Pumps in service for 30, 40 and 50 years, is constantly offered. This is the best evidence in proof of Cameron quality and excellence.

Cameron direct acting pumps are simple, durable and have no outside valve gear or moving parts.

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MARINE ENGINEERING
6 EAST 39th STREET NEW YORK

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., required by the Act of Congress of August 24, 1912, of INTERNATIONAL MARINE ENGINEERING, published monthly at New York, April 1, 1919.

State of New York, County of New York, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared E. L. Sumner, who, having been duly sworn, according to law, deposes and says that he is the Business Manager of INTERNATIONAL MARINE ENGINEERING, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—Aldrich Publishing Co., 6 East 39th St., New York.
Editor—H. H. Brown, 6 East 39th St., New York.
Managing Editor—H. L. Aldrich, 6 East 39th St., New York.
Business Manager—E. L. Sumner, 6 East 39th St., New York.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.) Aldrich Publishing Co., 6 East 39th St., New York; H. L. Aldrich, 6 East 39th St., New York; M. G. Aldrich, 6 East 39th St., New York.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages or other securities are: A. I. Aldrich, Manville, Rhode Island; A. E. Lord, Mt. Washington, Md.; George Slate, Summit, N. J.; H. H. Brown, 6 East 39th St., New York.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association or corporation has any interest direct or indirect in the said stock, bonds or other securities than as so stated by him.

E. L. SUMNER.

Sworn to and subscribed before me this 31st day of March, 1919.

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(My commission expires March 30, 1921.)

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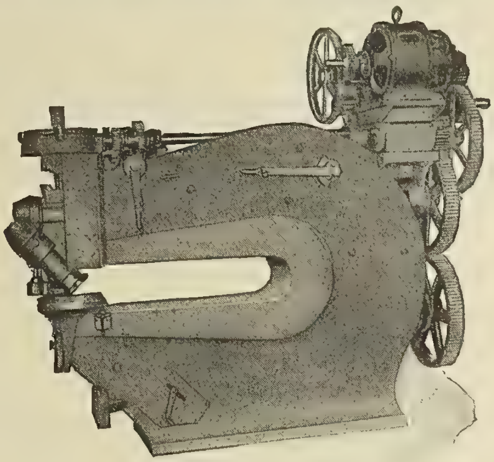

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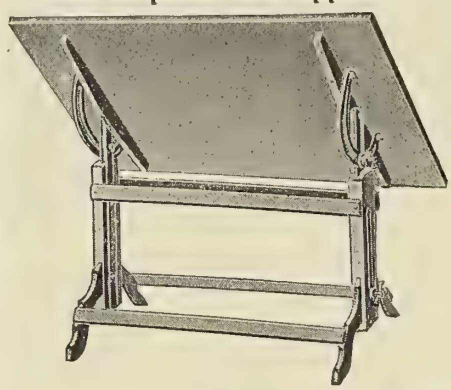

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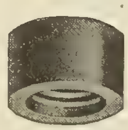

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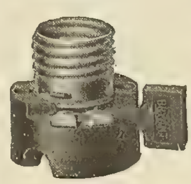

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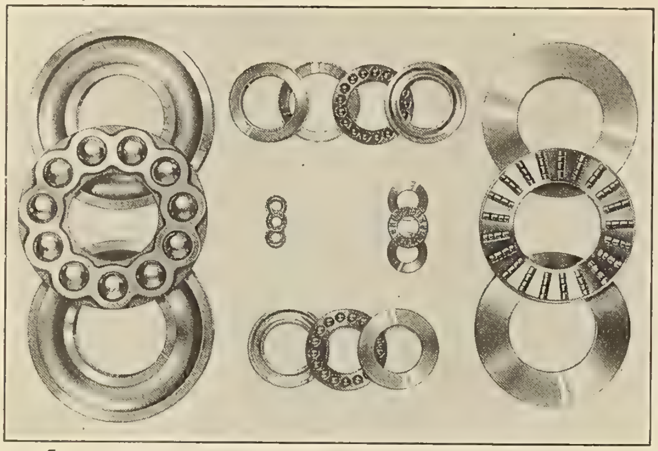

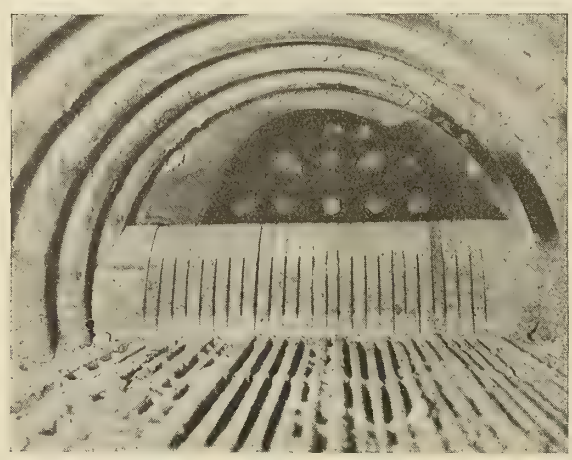

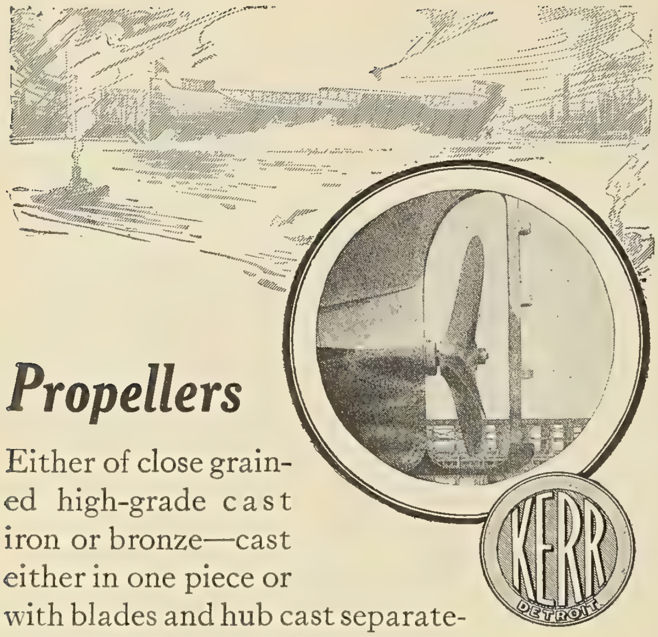

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Either of close grained high-grade cast iron or bronze—cast either in one piece or with blades and hub cast separately. We are prepared to furnish propellers of any type or size.

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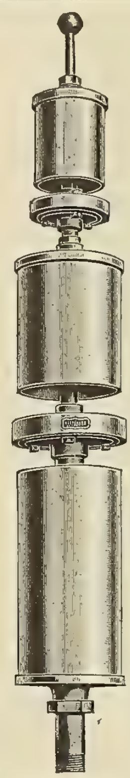

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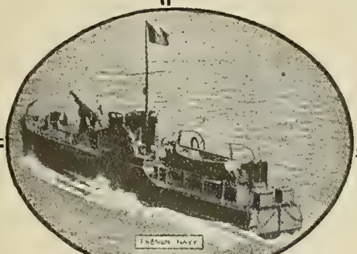

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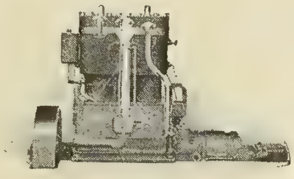

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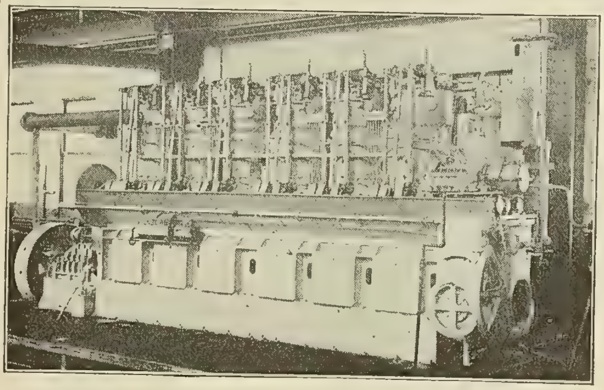

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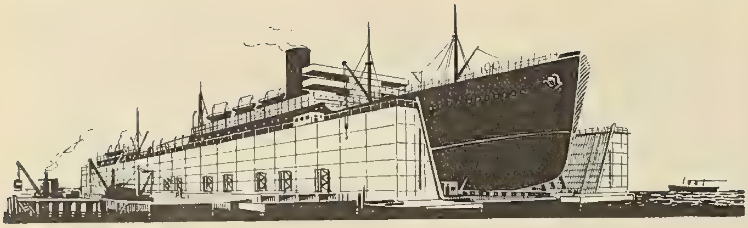

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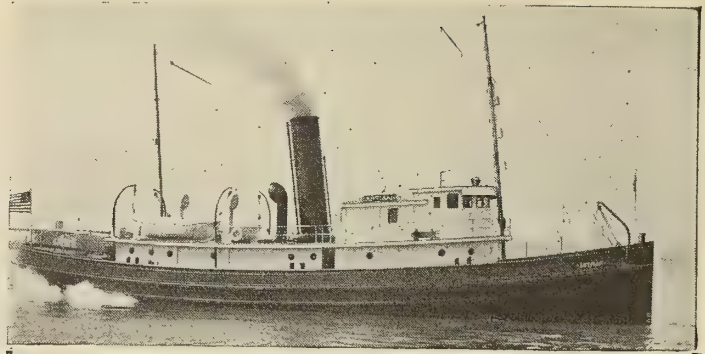

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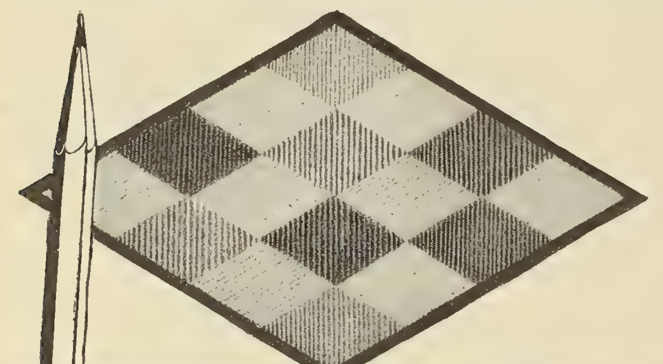

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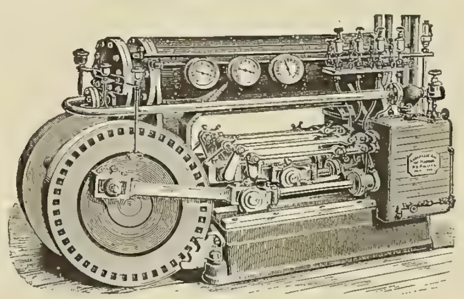

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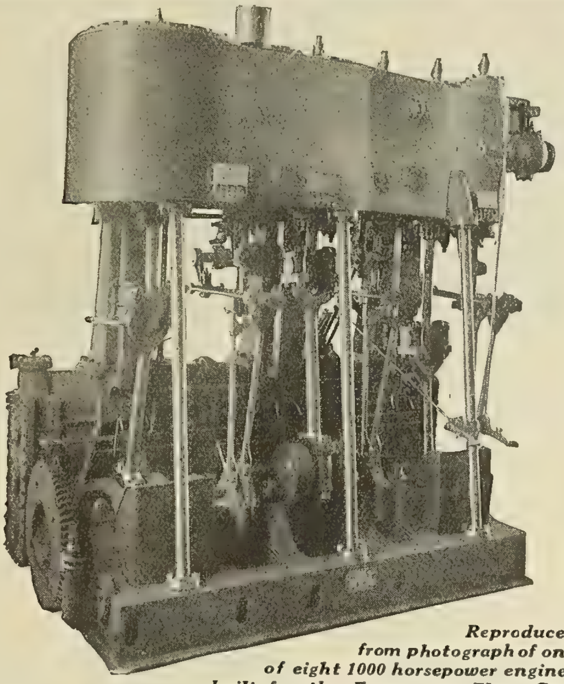

Reproduced from photograph of one of eight 1000 horsepower engines built for the Emergency Fleet Corporation for seagoing tugs.

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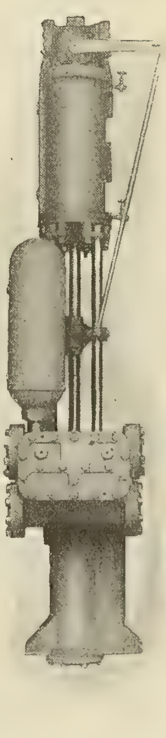

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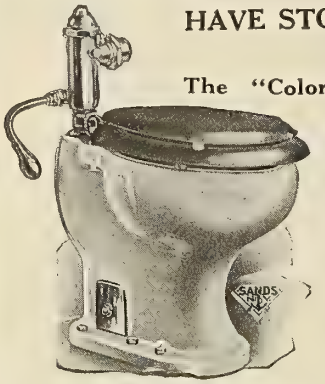

Plate F-1190

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Plat F-2590

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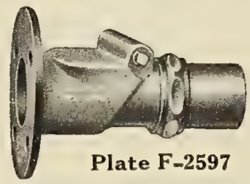

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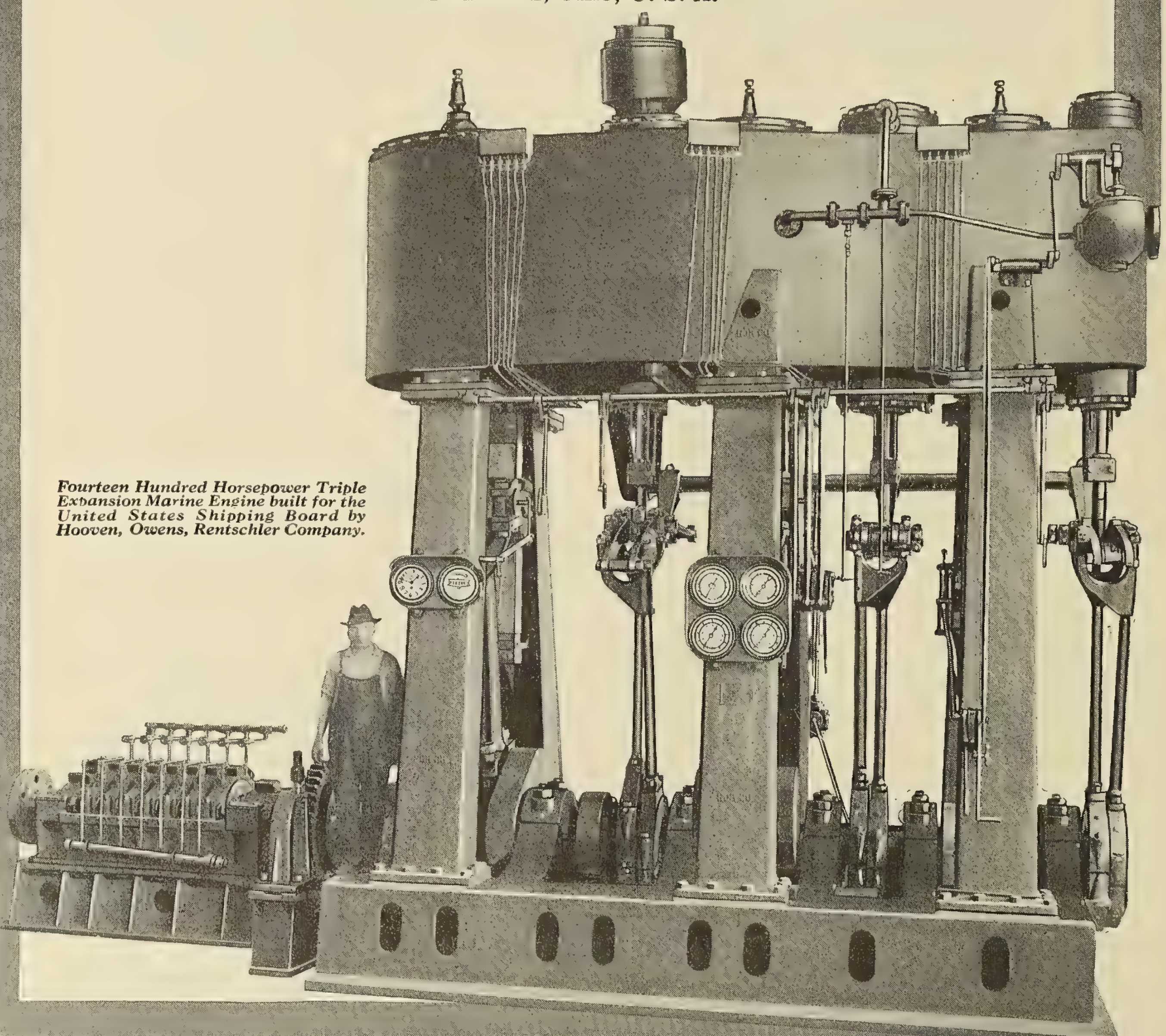

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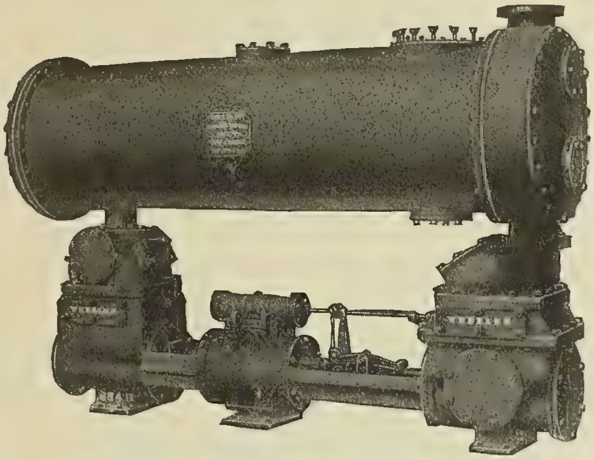

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New York Blue Print Paper Co.
Pease Co., C. F.
Weber & Co., F.

Boat Accessories.
American Balsa Co.
Eckliff Circulator Co.
Ferdinand, L. W., & Co.
Gwilliam Co., The.
Sands, A. B., & Son Co.
Steward Davit & Equipment Corp.

Boat Builders.
(See Launches and Yachts.)

Boat Davits.
(See Davits.)

Boat Fittings.
Ferdinand, L. W., & Co.
Sands, A. B., & Son Co.
Tiebout, W. & J.
Topping Brothers.

Boat Nails.
Malleable Iron Fittings Co.
Topping Brothers.

Boats.
(See Life Boats; also Launches and Yachts.)

Boilers.
(Also see Engine Builders.)
Almy Water Tube Boiler Co.
American Ship Building Co.
American Spiral Pipe Works.
Ames Shipbuilding & Dry Dock Co.
Babcock & Wilcox Co.
Badenhousen Co.
Baltimore Dry Docks & Shipbuilding Co.
Bethlehem Shipbuilding Corp.
Consolidated Shipbuilding Corp.
Fletcher, W. & A., Co.
Great Lakes Engineering Works.
Heine Safety Boiler Co.
Howden, James, & Co.
Hyde Windlass Co.
Kearfott Engineering Co.
Kingsford Foundry & Machine Co.
Manitowoc Ship Building Co.
Murray Iron Works Co.
New York Engineering Co.
Talbot Engineering Corporation.
Valk & Murdoch Co.
Vulcan Iron Works, Inc.
Ward, Charles, Engineering Wks.

Boiler Circulators.
Eckliff Circulator Co.
McNab Co., The.
Schutte & Koerting Co.

Boiler Coverings.
(See Non-Conducting Covering.)

Boiler Expanders.
Watson-Stillman Co.

Boiler Feeders.
(See Feed-Water Regulators.)

Boiler Feed Pumps.
(See Pumps.)
Alberger Pump & Condenser Co.
Buffalo Steam Pump Co.
Cameron Steam Pump Wks., A. S.
Davidson Co., M. T.
Dean Bros. Steam Pump Works.
De Laval Steam Turbine Co.
Fairbanks, Morse & Co.
Kingsford Foundry & Mach. Wks.
Morris Machine Works.
Schutte & Koerting Co.
Steam Motors Co.
Talbot Engineering Co.
Terry Steam Turbine Co.
Worthington Pump & Mach. Corp.

Boiler Flue Cleaners.
Diamond Power Specialty Co.
Independent Pneumatic Tool Co.
Otto & Sons, Inc., Albert.
Scully Steel & Iron Co.

Boiler Flue Cutters and Expanders.
Independent Pneumatic Tool Co.
Scully Steel & Iron Co.

Boiler Gauge Glasses.
(See Gauge Glasses.)

Boiler Graphite.
Dixon, Joseph, Crucible Co.

Boiler Makers' Test Pumps.
(See Test Pumps.)

Boiler Nozzles, Welded Steel.
American Spiral Pipe Works.
Continental Iron Works, The.

Boiler Plates.
(See Steel Plates.)

Boiler Riveters.
(See Power Riveters.)

Boiler Room Fittings.
American Steam Gauge & Valve Mfg. Co.
Ashton Valve Co.
Crane Co.
Howden, James, & Co.
Jerguson Gage & Valve Co.
Kearfott Engineering Co.
Kennedy Valve Mfg. Co.
Kinney Mfg. Co.
Lunkenheimer Co.
Mason Regulator Co.
National Tube Co.
Powell, Wm., Co.
Reid & Co., John.
Richardson-Phenix Co.
Row & Davis, Engineering, Inc.
Schutte & Koerting Co.
Union Water Meter Co.
Williams Valve Co., D. T.

Boiler Scalers.
Rotary Scraper Co.

Boiler Staybolts.
(See Staybolts.)

Boiler, Steam and Water Drums, Welded.
Continental Iron Works, The.

Boiler Tube Retarders.
National Tube Co.
Reid & Co., John.

Boiler Tubes.
Kearfott Engineering Co.
National Tube Co.
Parkesburg Iron Co.

Bolts and Nuts.
Larkin, J. K., & Co.
Mill and Mine Supply Co.
Russell, Burdsall & Ward Bolt & Nut Co.
Scully Steel & Iron Co.
Topping Brothers.

Booms—Tubular Steel.
National Tube Co.

Boring Bars.
(See Cylinder Boring Bars.)

Boring Machines.
(Metal Working.)
Ingersoll-Rand Co.
Niles-Bement-Pond Co.

Boring Machines.
(Wood.)
Chicago Pneumatic Tool Co.
Cleveland Pneumatic Tool Co.
Duntley-Dayton Co.
Independent Pneumatic Tool Co.
Ingersoll-Rand Co.

Boring and Turning Mills.
Niles-Bement-Pond Co.

Bottom Paints for Ships.
Bituco Mfg. & Chemical Co.
International Compositions Co.
Toch Brothers.

Brass and Copper.
Sands, A. B., & Son Co.

Brass Castings.
(See Castings—Brass.)

Brass Fittings.
American Steam Gauge & Valve Mfg. Co.
Ashton Valve Co.
Crane Co.
Kennedy Valve Mfg. Co.
Lunkenheimer Co.
Mason Regulator Co.
Powell Co., Wm.
Richardson-Phenix Co.
Sands, A. B., & Son Co.
Tiebout, W. & J.
Williams Valve Co., D. T.

Brazing Materials.
Smooth-On Mfg. Co.

Bridge Control.
Westinghouse Electric & Mfg. Co

Bridge Walls.
(See Furnace Bridge Walls.)

Brokers.
(See Ship Brokers.)

Bronze.
American Manganese Bronze Co.
Crane Co.
Duntley-Dayton Co.
Lunkenheimer Co.
Powell Co., The Wm.
Williams Valve Co., D. T.

Brushes.
(For all Marine Purposes.)
Whiting, John L.—J. J. Adams Co.

Bulb Sections.
Carnegie Steel Co.
General Steel Co.

Bunks.
Bernstein Manufacturing Co.
Foster Bros. Mfg. Co.
Southern-Rome Co.

Buoys.
Galbraith, C. C., & Son.
Sands, A. B., & Son Co.

Buoys, Ring.
Ferdinand, L. W., & Co.

Burners, Fuel Oil.
(See Fuel Oil Burners.)

Bushings.
Crane Co.
Hudson Block Co.
Lunkenheimer Co.
National Tube Co.

Butterfly Valves.
(See Valves.)

By-Pass Valves.
Crane Co., The.
Griscom-Russell Co.
Lunkenheimer Co.
Mason Regulator Co.
Powell Co., The Wm.
Schutte & Koerting Co.

Cables of All Kinds for Light and Power.
Standard Underground Cable Co.

Cables.
(See Chain; also Rope.)

Cableways.
(See Marine Cableways.)

Calking Machinery.
Ingersoll-Rand Co.

Calking Tools.
Topping Brothers.
Vulcan Tool Mfg. Co.

Canoe Glue.
Ferdinand, L. W., & Co.

Cantilever Cranes.
Terry Manufacturing Co., Ed. F.

Capstans.
(Steam, Electric, Hand.)
American Clay Machinery Co.
American Engineering Co.
American Ship Building Co.
Dake Engine Co.
Flory, S., Mfg. Co.
Hyde Windlass Co.
Mundy Hoisting Engine Co., J. S.
National Hoisting Engine Co.

Carbon Dioxide, Valves and Fittings.
Frick Co.
York Mfg. Co.

Carbon Dioxide Machines.
Frick Co.
Kroeschell Bros. Ice Machine Co.
York Manufacturing Co.

Car Dumpers.
McMyler-Interstate Co.
Brown Hoisting Machinery Co.

Cargo Hoists.
(See Hoisting Engines.)

Cargo Hooks.
Wilcox, Crittenden & Co.

Cargo Lights.
Benjamin Electric Mfg. Co.
Horne Mfg. Co.

Cargo Winches.
(See Winches.)

Castings—Aluminum.
Lunkenheimer Co.
Powell Co., The Wm.
Sands, A. B., & Son Co.

Castings—Brass.
American Standard Shipfittings Corp.
Benjamin Electric Mfg. Co.
Crane Co.
Fletcher, W. & A., Co.
Griscom-Russell Co.
Hyde Windlass Co.
Lunkenheimer Co.
Powell Co., The Wm.
Rostand Manufacturing Co.
Sands, A. B., & Son Co.
Tiebout, W. & J.
Valk & Murdoch Co.

Castings—Bronze.
American Manganese Bronze Co.
American Standard Shipfittings Corp.
American Steel Foundries
Benjamin Electric Mfg. Co.
Crane Co.
Fletcher, W. & A., Co.
Griscom-Russell Co.
Hyde Windlass Co.
Hooven, Owens, Rentschler Co.
Lunkenheimer Co.
Malleable Iron Fittings Co.
Mesta Machine Co.
Penn Seaboard Steel Corp.
Powell Co., The Wm.
Rostand Manufacturing Co.
Sands, A. B., & Son Co.
Tiebout, W. & J.
Williams Valve Co., D. T.

Castings—Gray Iron.
Central Foundry Co.

Castings—Steel.
American Clay Machinery Co.
American Standard Shipfittings Corp.
American Steel Foundries.
Central Foundry Co.
Crane Co.
Fletcher, W. & A., Co.
General Steel Co.
Griscom-Russell Co.
Hardie-Tynes Manufacturing Co.
Hyde Windlass Co.
Hooven, Owens, Rentschler Co.
Lunkenheimer Co.
Mesta Machine Co.
Penn Seaboard Steel Corp.
Sands, A. B., & Son Co.
Valk & Murdoch Co.

Castors.
(For handling plates in shipyards.)
Hart Roller Bearing Co.
Terry Mfg. Co., Edward F.

Ceilings.
(Cabin.)
Marine Decking & Supply Co.

Cement—Linoleum.
Ferdinand, L. W., & Co.

Cement Waterproofing.
Bituco Mfg. & Chemical Co.

Centrifugal Oil Purifiers.
De Laval Separator Co.

Centrifugal Pumps.
Alberger Pump & Condenser Co.
Buffalo Steam Pump Co.
Cameron Steam Pump Wks., A. S.
Fairbanks, Morse & Co.
Morris Machine Works.
Steam Motors Co.
Westinghouse Electric & Mfg. Co.
Wheeler Manufacturing Co., C.H.
Worthington Pump & Mach. Corp.

Chain.
Larkin, J. K., & Co.
Mill and Mine Supply Co.
Scully Steel & Iron Co.
Topping Brothers.

Chain Hoists and Blocks.
Ford Chain Block & Mfg. Co.
Scully Steel & Iron Co.
Topping Brothers.
Wyatt, Thos., Mfg. Co.
Yale & Towne Mfg. Co.

Chain Pipe.
Central Foundry Co.

Chains for Marine Purposes.
McNab Co., The.
Wyatt, Thos., Mfg. Co.

Chain Pipe Wrenches.
(See Wrenches.)

Chain Stoppers.
American Engineering Co.

Chain Valve Wheels.
Babbitt Steam Specialty Co.
Lunkenheimer Co.
Powell Co., The Wm.

Chandlery Stores.
Hudson Block Co.

Charcoal Iron Boiler Tubes.
Parkesburg Iron Co.

Check Valves—Brass & Iron.
Crane Co., The.
Kennedy Valve Mfg. Co.
Lunkenheimer Co.
Mott Iron Works, J. L.
Powell Co., The Wm.
Pratt & Cady Co., Inc.
Sands & Son, A. B.
Schutte & Koerting Co.
Watson-Stillman Co.

Chipping Hammers.
(See Pneumatic Tools.)

Chisels.
Scully Steel & Iron Co.
Vulcan Tool Mfg. Co.

Chisel Blanks.
Cleveland Steel Tool Co.
Cleveland Punch & Shear Works Co.
Ingersoll-Rand Co.
Scully Steel & Iron Co.

Chronometer Valves.
Union Water Meter Co.

Chronometers.
McNab Co., The.

Chocks.
American Engineering Co.
Central Foundry Co.
Great Lakes Engineering Works.

Chucks.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Morse Twist Drill & Machine Co.
Rich Tool Co.
Rostand Manufacturing Co.
Thomas Elevator Co.

Circulating Pumps.
Alberger Pump & Condenser Co.
Buffalo Steam Pump Co.
Cameron Steam Pump Wks., A. S
Davidson Co., M. T.
Dean Bros. Steam Pump Works.
De Laval Steam Turbine Co.
Epping-Carpenter Pump Co.
Fairbanks, Morse & Co.
Howden, James, & Co., Ltd.
Kingsford Foundry & Mach. Co.
Morris Machine Works.
Steam Motors Co.
Terry Steam Turbine Co.
Westinghouse Electric & Mfg. Co.
Wheeler Mfg. Co., C. H.
Worthington Pump & Mach. Corp.

Circulators.
(See Boiler Circulators.)

Clamps.
Williams & Co., J. H.

Clamps—Boiler.
Scully Steel & Iron Co.
Topping Brothers.

Classification Association.
American Bureau of Shipping.

Clinch Rings.
Galbraith, C. C., & Son.
Malleable Iron Fittings Co.
Topping Brothers.

Clocks.
American Steam Gauge & Valve Mfg. Co.
Ashton Valve Co.
Hand, John E., & Sons Co.
McNab Co., The.

Coal-Handling Machinery.
Brown Hoisting Machinery Co.
Lakeside Bridge & Steel Co.
Lidgerwood Mfg. Co.
McMyler-Interstate Co.
Mundy, J. S., Hoisting Engine Co.
National Hoisting Engine Co.
Shepard Elec. Crane & Hoist Co.

Coatings.
(See Anti-Rust Coatings.)

Cocks.
(See Gauge Cocks.)

Cold Saws.
Greenfield Tap & Die Corp.

Combined Air & Circulating Pumps.
Dean Bros. Steam Pump Works.
Wheeler Manufacturing Co.

Companion Flanges.
Crane Co.
Lunkenheimer Co.
National Tube Co.
Powell Co., The Wm.

Compasses.
Hand, John E., & Sons Co.
Sperry Gyroscope Co.
McNab Co., The.

Compensators.
(See Automatic Compensators.)

Compositions.
(See Ship's Compositions.)

Compression Riveters.
(See Power Riveters.)

Condensers.
Alberger Pump & Condenser Co.
American Engineering Co.
Buffalo Steam Pump Co.
Consolidated Shipbuilding Corp.
Davidson, M. T., Co.
Dean Bros. Steam Pump Works.
Fletcher, W. & A., Co.
Great Lakes Engineering Works.
Griscom-Russell Co.
Kearfott Engineering Co.
Ross Heater & Mfg. Co.
Row & Davis, Engineers.
Schutte & Koerting Co.
Talbot Engineering Corporation.
Wheeler Manufacturing Co., C. H.
Westinghouse Electric & Mfg. Co.
Worthington Pump & Mach. Corp.

Condenser Tubes.
Kearfott Enginering Co.
Wheeler Condenser & Engineering Co.

Connecting Rods.
Heppenstall Forge & Knife Co.
Pacific Construction & Engineering Co.
Williams & Co., J. H.

Consulting Engineers.
(See Professional Cards.)

Contract Work.
Hanna Engineering Works.

Conveying Machinery.
Brown Hoisting Machinery Co.
Byers Machine Co., John F.
Dravo Contracting Co.
Lakeside Bridge & Steel Co.
Lidgerwood Mfg. Co.
Manning, Maxwell & Moore.
McMyler-Interstate Co.
Mundy, J. S., Hoisting Engine Co.
National Hoisting Engine Co.
Terry Mfg. Co., Edward F.

Conveyors (Coal)
(See Conveying Machinery.)

CO^2 Ice Machines.
(See Carbon-Dioxide Machines.)

Coolers—Oil.
(See Oil Coolers.)

Copper.
(See Brass and Copper.)

Copper Paint for Wooden Vessels.
International Compositions Co.

Coppersmiths.
Badger, E. B., & Sons.

Copper Tubes, Rods, Wires.
Standard Underground Cable Co.

Cordage.
(Also see Rope and Wire Rope; also Twine.)
American Manufacturing Co.
Columbian Rope Co.
Durable Wire Rope Co.
Griscom-Russell Co.
Moon Co., Geo. C.
Plymouth Cordage Co.
Samson Cordage Works.
Waterbury Co.
Whitlock Cordage Co.

Cork Cement.
Ferdinand, L. W., & Co.

Corrugated Furnaces.
American Spiral Pipe Works.
Continental Iron Works, The.
Howden, James, & Co.
McNab Co., The.

Counters.
(See Revolution Counters.)

Countersinking Machines.
Lakeside Bridge & Steel Co.

Countersinks.
Standard Tool Co.

Coupling.
(See Hose Coupling.)

Coverings—Non-conducting.
(See Non-Conducting Covering.)

Cowls.
Ohio Blower Co.

Cranes.
(Also see Floating Cranes and Shipyard Whirlers.)
American Balsa Co.
American Engineering Co.
Brown Hoisting Machinery Co.
Byers Machine Co., John.
Chambersburg Engineering Co.
Dravo Contracting Co.
Lakeside Bridge & Steel Co.
McMyler-Interstate Co.
Manitowoc Ship Building Co.
Manning, Maxwell & Moore.
Milwaukee Electric Crane & Mfg. Co.
Niles-Bement-Pond Co.
Pawling & Harnischfeger Co.
Shepard Elec. Crane & Hoist Co.
Sprague-Electric Works.
Terry Mfg. Co., Edward F.
Topping Brothers.

Crank Shafts.
Great Lakes Engineering Works.
Pacific Construction & Engineering Co.

Cutters.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
Pratt & Whitney Co.

Cutting Compounds.
Moore Oil Co.
Texas Co., The.

Cutting and Welding.
(See Welding.)

Cylinder Boring Bars.
Niles-Bement-Pond Co.
Williams & Co., J. H.

Cylinder Relief Valves.
(See Valves.)

Cylinders for Compressed Air, Gas, Etc.
Continental Iron Works, The.
National Tube Co.

Davits.
American Balsa Co.
Steward Davit & Equipment Corp.
McNab Co., The.

Deck Hoists.
(See Hoisting Engines.)

Deck Plates.
Carnegie Steel Co.
Sands, A. B., & Son Co.

Deck Pumps.
Dean Bros. Steam Pump Works.
Sands & Son Co., A. B.

Decking.
Marine Decking & Supply Co.

Depth Recorders.
Hand, J. E., & Sons Co.

Derricks.
Lakeside Bridge & Steel Co.
Lidgerwood Manufacturing Co.
McMyler-Interstate Co.
Terry Mfg. Co., Edward F.

Derrick Cars.
McMyler-Interstate Co.
Terry Mfg. Co., Edward F.

Derrick Irons.
Lidgerwood Manufacturing Co.
Terry Mfg. Co., Edward F.

Diaphragm Pumps.
Hyde Windlass Co.

Die Blocks.
Heppenstall Forge & Knife Co.
General Steel Co.

Dies.
Brubaker & Bros., W. L.
Cleveland Punch & Shear Works Co.
Cleveland Steel Tool Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
Scully Steel & Iron Co.

Diesel Engines.
(Also see Engines, Oil.)
American Clay Machinery Co.
Johannsen, H. S.
Kearfott Engineering Co.
McIntosh & Seymour Corp.
Midwest Engine Co.
New London Ship & Engine Co.
Winton Engine Works.

Direct-Connected Sets.
(See Electrical Plants.)

Direction and Revolution Indicators.
McNab Co., The.

Disengaging Gears.
American Balsa Co.
Eckliff Circulator Co.
Steward Davit & Equipment Corp.

Distillers.
(See Evaporators.)

Diving Apparatus.
Morse, Andrew J., & Son, Inc.

Draft Gauges.
McNab Co., The.

Draft Indicators.
Pneumerator Co.

Drafting Instruments.
New York Blue Print Paper Co.
Pease, C. F., Co.
Starrett, L. S., Co.
Weber, F., & Co.

Drain Valves.
(See Valves.)

Drawing Materials.
(Board, Cloth, Paper, Ink, etc.)
New York Blue Print Paper Co.
Pease, C. F., Co.
Starrett, L. S., Co.
Weber & Co., F.

Drawing Pencils.
American Lead Pencil Co.
Dixon Crucible Co.
Weber & Co., F.

Drafting Room Furniture.
New York Blue Print Paper Co.

Dredges.
Great Lakes Engineering Works.
Manitowoc Ship Building Co.
Morris Machine Works.

Dredging Machinery.
Alberger Pump & Condenser Co.
American Engineering Co.
Fletcher, W. & A.
Flory, S., Mfg. Co.
Great Lakes Engineering Works.
Lidgerwood Manufacturing Co.
McMyler-Interstate Co.
Morris Machine Works.
Mundy Hoisting Engine Co., J. S.

Dredging Pumps.
Kingsford Foundry & Mach. Wks.
Morris Machine Works.
Terry Steam Turbine Co.
Worthington Pump & Mach. Corp.

Drift Pins.
Cleveland Punch & Shear Works Co.
Cleveland Steel Tool Co.

Scully Steel & Iron Co.
Topping Brothers.
Vulcan Tool Mfg. Co.

Drilling Machines.
Lakeside Bridge & Steel Co.
Lynd-Farquhar Co.
Niles-Bement-Pond Co.
Scully Steel & Iron Co.

Drills.
Morse Twist Drill & Machine Co.
Rich Tool Co.
Whitman & Barnes Mfg. Co.

Drills, Electric.
(See Electric Drills.)

Drills, Pneumatic.
(See Air Drills.)

Drills, Portable.
(See Portable Drills.)

Drills—Wall Radial.
(See Radial Drills.)

Drop Forgings.
(Eye Bolts, Wrenches, Etc.)
Camden Forge Co.
General Steel Co.
Savage Arms Corp.
Whitman & Barnes Mfg. Co.
Williams, J. H., & Co.

Drop Hammers.
Chambersburg Engineering Co.
Niles-Bement-Pond Co.

Dry Dock Pumps.
Cameron Steam Pump Wks., A. S.
Great Lakes Engineering Works.
Morris Machine Works.
Worthington Pump & Mach. Corp.

Dry Docks and Marine Railways.
Baltimore Dry Docks & Shipbuilding Co.
Great Lakes Engineering Works.

Newport News Shipbuilding & Dry Dock Co.
Todd Shipyards Corporation.
Union Dry Dock & Repair Co.
Valk & Murdoch Co.

Dry Docks.
(Marine Railway, Manufacturer.)
Crandall Engineering Co.
Great Lakes Engineering Works.

Dynamic Balancing Machines
Crawford Tool & Mfg. Co.

Dynamos.
(See Electric Plants.)

Eccentric Rods.
Pacific Construction & Engineering Co.

Economizers, Fuel.
(See Fcel Economizer.)

Ejectors.
Lunkenheimer Co.
Schutte & Koerting Co.

Electric Cranes.
(See Electric Hoists.)

Electric Drills and Grinders.
Chicago Pneumatic Tool Co.
Cincinnati Electrical Tool Co.
Duntley-Dayton Co.
General Electric Co.
Independent Pneumatic Tool Co.
United States Electrical Tool Co.

Electric-Driven Pumps.
Blackmer Rotary Pump Co.
Cameron Steam Pump Wks., A. S.
Dean Bros. Steam Pump Works.
Kin ey Manufacturing Co.

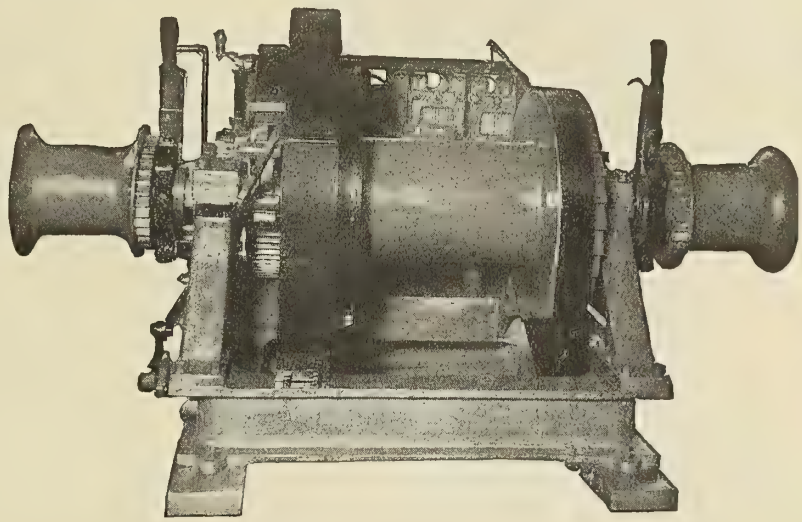
Electrical Appliances, Installations, Fittings and Supplies.
Benjamin Electric Mfg. Co.

THOMAS SHIP WINCHES
STEAM AND ELECTRIC

TYPES:
KEYED DRUMS
FRICTION DRUMS
KEYED WINCHES
CLUTCH WINCHES

HEAVY DUTY HOISTS
FOR FITTING BASINS

DERRICK HOISTS
FOR SHIP YARDS
AND DOCKS



Manufactured By
THOMAS ELEVATOR COMPANY
25 SO. HOYNE AVE. CHICAGO, ILLINOIS
NEW YORK OFFICE: 50 CHURCH STREET

Johannsen, H. S.
Kearfott Engineering Co.
Knowlson & Kelley Co.
McIntosh & Seymour Corp.
Manitowoc Ship Building Co.
Midwest Engine Co.
Mietz Corporation, August.
Morris Machine Works.
Murray Iron Works Co.
New London Ship & Engine Co.
Parsons Mar. Steam Turbine Co.
Reid & Co., John.
Sheriffs Mfg. Co.
Skandia Oil Engines.
Standard Motor Construction Co.
Steam Motors Co.
Sturtevant Co., B. F.
Talbot Engineering Corporation.
Trout, H. G., Co.
Vulcan Iron Works, Inc.
Ward, Chas., Engineering Works
Winton Engine Co.
Wolverine Motor Works.

Engines, Pumping.
Alberger Pump & Condenser Co.
Davidson, M. T., Co.
Epping-Carpenter Pump Co.
Fairbanks, Morse & Co.
Griscom-Russell Co.
Morris Machine Works.
Row & Davis, Engineers, Inc.
Steam Motors Co.
Terry Steam Turbine Co.
Worthington Pump & Mach. Corp

Engine-Room Clocks.
(See Clocks.)

Engine Room Gratings.
Irving Iron Works Co.

Engine-Room Supplies.
(See Steam Specialties.)

Engine-Room Telegraphs.
Chadburn (Ship) Telegraph Co.
McNab Co., The.

Erasers.
Dixon Crucible Co., Joseph.
New York Blue Print Paper Co.

Erectors' Tools.
Terry Mfg. Co., Edward F.

Evaporators.
Alberger Pump & Condenser Co.
American Engineering Co.
Davidson, M. T., Co.
Griscom-Russell Co.
Kearfott Engineering Co.
Ross Heater & Mfg. Co.
Row & Davis, Engineers, Inc.
Schutte & Koerting Co.
Talbot Engineering Corporation.

Exhaust Fans.
(See Blowers.)

Expanders.
(See Boiler Flue Expanders and Pipe Expanding and Flanging Machines.)

Expansion Joints.
Alberger Pump & Condenser Co.
Crane Co.
Griscom-Russell Co.
Lunkenheimer Co.
National Tube Co.
Powell Co., The Wm.
Ross Heater & Mfg. Co.

Fabrikoid.
Du Pont Fabrikoid Co.

Factory Builders.
(See Builders.)

Fans.
(See Blowers.)

Feed Water Heaters.
Griscom-Russell Co.
Kearfott Engineering Co.
Ross Heater & Mfg. Co.
Row & Davis, Engineers, Inc.
Schutte & Koerting Co.

Feed Water Regulators.
Alberger Pump & Condenser Co.
Jerguson Gage & Valve Co.
Kearfott Engineering Co.

Fences.
(See Wire Fences.)

Ferrules—Condenser Tube.
(See Condenser Tube Ferrules.)

Files.
Nicholson File Co.
Whitman & Barnes Mfg. Co.

Filing Cabinets.
Pease Co., C. F.

Filters—Marine Oil.
Griscom-Russell Co., New York.
Kearfott Engineering Co.
Richardson-Phenix Co.
Ross Heater & Mfg. Co.
Row & Davis, Engineers, Inc.
Schutte & Koerting Co.

Fire Alarm Systems.
Edwards & Co.
Klaxon Co.

Fire Department Supplies.
Morse, Andrew J., & Son, Inc.

Fire Extinguishers.
(Also see Fire Protection.)
Morse, Andrew J., Son, Inc.
Schutte & Koerting Co.

Fire Hose.
(See Hose.)

Fireproof Lumber.
(See Lumber, Fireproof.)

Fire Protection.
General Fire Extinguisher Co.

Fire Pumps.
Blackmer Rotary Pump Co.
Buffalo Steam Pump Works.
Dean Bros. Steam Pump Works.
Epping-Carpenter Pump Co.
Morris Machine Works.
Worthington Pump & Mach. Corp

Flags and Pennants.
Granger, Geo. B., Co.

Flanges.
American Spiral Pipe Works.
Crane Co.
Dart, E. M., Mfg. Co.
Lunkenheimer Co.
National Tube Co.
Scully Steel & Iron Co.
Williams Valve Co., D. T.

Flanging Machines.
Chambersburg Engineering Co.
McCabe Mfg. Co.
Niles-Bement-Pond Co.
Scully Steel & Iron Co.
Watson-Stillman Co.

Flexible Shafting.
Rotary Scraper Co.

Flexible Staybolts.
American Flexible Bolt Co.

Floating Cranes.
(Also see Cranes.)
Great Lakes Engineering Works.
McMyler-Interstate Co.
Manitowoc Ship Building & Dry Dock Co.
Terry Mfg. Co., Edward F.

Float Valves.
Crane Co.
Lunkenheimer Co.
Mason Regulator Co.

Floating Dry Docks.
(See Dry Docks.)

Floor Gratings.
Irving Iron Works Co.

Floor Plates.
Carnegie Steel Co.
Crane Co.
Scully Steel & Iron Co.

Flow Indicators—Water-Oil.
Richardson-Phenix Co.

Flue Cleaners.
(See Boiler Flue Cleaners.)

Flue Cutters.
(See Boiler Flue Cutters.)

Flue Hole Punches and Dies.
Cleveland Punch & Shear Works Co.

Fog Horns.
Hand, John E., & Sons Co.
Klaxon Co.

Folding Anchors.
Malleable Iron Fittings Co.

Forced Draft.
(See also Blowers.)
De Laval Steam Turbine Co.
General Electric Co.
Howden, James, & Co.
Reid & Co., John.
Steam Motors Co.
Terry Steam Turbine Co.
Westinghouse Machine Co.

Forges.
Buffalo Forge Co.
Metals Production Equipment Co.
Scully Steel & Iron Co.

Forgings, Bronze.
American Standard Shipfittings Corp.
Camden Forge Co.
Hyde Windlass Co.

Forgings, Iron and Steel.
(Also see Drop Forgings.)
American Standard Shipfittings Corp.
Camden Forge Co.
Carnegie Steel Co.
General Steel Co.
Heppenstall Forge & Knife Co.
Mesta Machine Co.
Pacific Construction & Engineering Co.
Penn Seaboard Steel Corp.
Savage Arms Corp.
United Engineering & Fdy. Co.
Valk & Murdoch Co.

Freight-Handling Equipment
Brown Hoisting Machinery Co.
Dravo Contracting Co.
Lakeside Bridge & Steel Co.
Lidgerwood Mfg. Co.
McMyler-Interstate Co.
Manning, Maxwell & Moore.
Mundy, J. S., Hoisting Engine Co.
National Hoisting Engine Co.
Shepard Elec. Crane & Hoist Co.
Sprague Electric Works.
Terry Mfg. Co., Edward F.

Frigidometers.
McNab Co., The.

Frostproof Coverings.
Ferdinand, L. W., & Co.

Fuel Economizers.
Diamond Power Specialty Co.
Griscom-Russell Co.
Magnesia Association of America.
Sturtevant Co., B. F.
Talbot Engineering Corporation.

Fuel Oil Atomizers.
Schutte & Koerting Co.

Fuel Oil Burners.
Schutte & Koerting Co.
Talbot Engineering Corporation.

Fuel Oil Heaters.
Griscom-Russell Co.

Furnace Bridge Walls.
Wager Furnace Bridge Wall Co., Inc.

Furnace Fronts.
Continental Iron Works, The.
Fletcher, W. & A., Co.
Great Lakes Engineering Works.
Howden, James, & Co.
Reid & Co., John.

Furnaces.
(Also see Oil Furnaces.)
American Spiral Pipe Works.
Continental Iron Works, The.
McNab Co., The.
Scully Steel & Iron Co.

Fusible Plugs.
Crane Co.
Griscom-Russell Co.
Lunkenheimer Co.
Williams Valve Co., D. T.

Galley Pumps.
Mott Iron Works, J. L.
Sands & Son Co., A. B.

Galleys.
(See Ranges.)

Galvanized Material.
Larkin, J. K., & Co.
Sands, A. B., & Son Co.
Tiebout, W. & J.
Topping Brothers.

Gantry Cranes.
Terry Mfg. Co., Edward F.

Gaskets.
(Also see Packing.)
Albion Mfg. Co.
Crane Co.
General Asbestos & Rubber Co.
Goodrich Rubber Co., B. F.
Griscom-Russell Co.
New York Belting & Packing Co.
Scully Steel & Iron Co.
Smooth-On Mfg. Co.
United States Rubber Co.

Gasoline.
Texas Co., The.

Gasoline Engines.
Consolidated Shipbuilding Corp.
Fairbanks, Morse & Co.
Standard Motor Construction Co.
Winton Engine Co.
Wolverine Motor Works.

Gasoline Pumps.
Blackmer Rotary Pump Co.
Sands & Son Co., A. B.

Gas Engine Specialties.
Crane Co.
Lunkenheimer Co.
Powell, Wm., Co.
Williams Valve Co., D. T.

Gas Producers.
Nelson Blower & Furnace Co.
Schutte & Koerting Co.

Gate Valves—Brass and Iron.
Crane Co.
Kennedy Valve Mfg. Co.
Lunkenheimer Co.
Powell Co., The Wm.
Pratt & Cady.
Schutte & Koerting Co.

Gate Valves for Tank Steamers.
Pratt & Cady Co., Inc.

Gauge Cocks.
American Steam Gauge & Valve Mfg. Co.
Jerguson Gage & Valve Co.
Lunkenheimer Co.
Powell Co., The Wm.
Pratt & Cady Co., Inc.
Sands, A. B., & Son Co.
Williams Valve Co., D. T.

Gauge Glasses.
Crane Co.
Jerguson Gage & Valve Co.
Lunkenheimer Co.
Powell Co., The Wm.
Williams Valve Co., D. T.

Gauges.
(Draft, Trim & Ton Displacement)
Pneumercator Co.

Gauges—Drill.
Morse Twist Drill & Machine Co.

Gauges—Manufacturers'.
(Also see Steam Gauges.)
Greenfield Tap & Die Corp.
Manning, Maxwell & Moore.
Starrett Co., L. S.

Gauge Testers.
American Steam Gauge & Valve Mfg. Co.

Gears.
De Laval Steam Turbine Co.
Falk Co., The.
Savage Arms Corp.
Westinghouse Electric & Mfg. Co.

Gear Blanks—Rolled Steel.
Carnegie Steel Co.

General Welding and Cutting Equipment.
(See Welding and Cutting Apparatus and Supplies.)

Generating Sets.
Engberg's Electric & Mechanical Works.
Fairbanks, Morse & Co.
General Electric Co.
Mietz Corporation, August.
Steam Motors Co.
Terry Steam Turbine Co.
Westinghouse Electric & Mfg. Co.

Generators.
Benjamin Electric Mfg. Co.
Bryant Electric Co.
Crouse-Hinds Co.
Fairbanks, Morse & Co.
General Electric So.

Globe Valves—Brass & Iron.
Crane Co.
Kennedy Valve Mfg. Co.
Lunkenheimer Co.
Powell Co., The Wm.
Pratt & Cady Co., Inc.
Schutte & Koerting Co.

Glue—Marine.
Ferdinand, L. W., & Co.

Governor Valves.
Crane Co.
Lunkenheimer Co.
Schutte & Koerting Co.
Union Water Meter Co.

Graphite.
Dixon, Jos., Crucible Co.

Gratings—For Engine Room Floors, Etc.
Irving Iron Works Co.

Grease.
(See Lubricants.)

Grease Cups.
Albany Lubricating Co.
Crane Co.
Lunkenheimer Co.
Powell Co., The William.
Sun Co.

Grease Extractors.
American Steam Gauge & Valve Mfg. Co.
Griscom-Russell Co.
Row & Davis, Engineers, Inc.
Schutte & Koerting Co.

Grinders, Electric and Pneumatic.
Chicago Pneumatic Tool Co.
Duntley-Dayton Co.
Greenfield Tap & Die Corp.
Independent Pneumatic Tool Co.
United States Electrical Tool Co.

Grinding Machines.
(Plain and Universal.)
Morse Twist Drill & Machine Co.

Guillotine Shears.
Cleveland Punch & Shear Works Co.
Hilles & Jones Co.
Niles-Bement-Pond Co.

Gypseys.
American Engineering Co.
Hyde Windlass Co.
Lidgerwood Manufacturing Co.
Mundy Hoisting Engine Co., J. S.

Gyro-Compasses.
Sperry Gyroscope Co.

Gyro-Stabilizer.
Sperry Gyroscope Co.

Hammers.
Bradley & Son, C. C.

Hammers, Pneumatic.
(See Pneumatic Tools.)

Hammers, Steam.
Chambersburg Engineering Wks.
Scully Steel & Iron Co.

Hammocks.
(See Couch Hammocks.)

Hardware.
(See Marine Hardware.)

Hardwood.
(See Lumber.)

Hawser Reels.
Central Foundry Co.

Hawsers—Manila.
(Also see Rope and Wire Rope.)
American Manufacturing Co.
Columbian Rope Co.
McNab Co., The.
Plymouth Cordage Co.
Waterbury Co.
Whitlock Cordage Co.

Heat Insulation.
(Also see Non-Conducting Coverings.)
American Balsa Co.
Magnesia Association of America.

Heaters.
(Bath, Lavatory, Shower.)
Alberger Pump & Condenser Co.
Griscom-Russell Co.
Kearfott Engineering Co.
Mott Iron Works, J. L.
Ross Heater & Mfg. Co.
Sands, A. B., & Son Co.
Schutte & Koerting Co.

Hemp.
(See Twine.)

Hoisting Engines.
American Clay Machinery Co.
American Engineering Co.
American Ship Building Co.
Dake Engine Co.
Great Lakes Engineering Works.
Fairbanks, Morse & Co.
Flory, S., Mfg. Co.
Hyde Windlass Co.
McNab Co., The.
Lidgerwood Mfg. Co.
Mundy, J. S., Hoisting Engine Co.
National Hoisting Engine Co.
Scully Steel & Iron Co.
Thomas Elevator Co.

Hoisting and Transmission Rope.
(See Rope.)

Hoists, Chain.
(See Chain Hoists.)

Hoists, Electric.
(See Electric Hoists.)

Holders-On.
Chicago Pneumatic Tool Co.
Duntley-Dayton Co.
Ingersoll-Rand Co.
Scully Steel & Iron Co.

Horizontal Punches.
Cleveland Punch & Shear Works Co.

Hose.
(Also see Air Hose.)
Chicago Pneumatic Tool Co.
Duntley-Dayton Co.
Independent Pneumatic Tool Co.
Ingersoll-Rand Co.
New York Belting & Packing Co.
Oldham, Geo., & Son Co.
Scully Steel & Iron Co.

Hose Coupling.
Chicago Pneumatic Tool Co.
Cleveland Pneumatic Tool Co.
Duntley-Dayton Co.
Independent Pneumatic Tool Co.
Ingersoll-Rand Co.
New York Belting & Packing Co.
Oldham, Geo., & Son Co.
Scully Steel & Iron Co.

Hose Nozzles.
Morse, Andrew J., Son, Inc.

Humidifiers.
Griscom-Russell Co.
Schutte & Koerting Co.

Hydraulic Fittings.
Crane Co.
Lunkenheimer Co.
Powell, Wm., Co.
Watson-Stillman Co.

Hydraulic Presses and Other Machinery.
Chambersburg Engineering Co.
Mesta Machine Co.
Niles-Bement-Pond Co.
Watson-Stillman Co.

Hydrogen Generating Plants.
Davis-Bournonville Co.

Hydrometers.
Taylor Instrument Co.'s.
McNab Co., The.

Hygrodeiks.
Taylor Instrument Co.'s.

Hygrometers.
Taylor Instrument Co.'s.

Ice Detectors.
McNab Co., The.

Ice Machines.
(See Refrigerating Machinery.)

Indicator Connections.
Lunkenheimer Co.
Powell Co., The Wm.

Indicators.
(Steam and Gas Engine.)
American Steam Gauge & Valve Mfg. Co.
Ashton Valve Co.
Lunkenheimer Co.
Manning, Maxwell & Moore.
McNab Co., The.
Powell Co., The William.

Injectors.
Lunkenheimer Co.
Manning, Maxwell & Moore.
Powell Co., The William.
Schutte & Koerting Co.

Interlocking Rubber Tiling.
Griscom-Russell Co.
New York Belting & Packing Co.

Iron.
Central Iron & Steel Co.
Mill and Mine Supply Co.
Scully Steel & Iron Co.

Iron Cement.
Smooth-On Mfg. Co.

Iron Pipe.
(See Pipe.)

Jacks.
(Pneumatic.)
Gracey, R., & Sons Co.
Independent Pneumatic Tool Co
Scully Steel & Iron Co.
Topping Brothers.
Watson-Stillman Co.

Jacks, Hydraulic.
Watson-Stillman Co.

Jacks—Steamboat Ratchet.
(Pulling.)
Gracey, R., & Sons Co.
Griscom-Russell Co.

Jinniwinks.
Terry Manufacturing Co., Ed. F.

Journal Bearings.
(See Thrust Bearings.)

Jute.
American Manufacturing Co.
Columbian Rope Co.

Kerosene Engines.
Consolidated Shipbuilding Corp.
Fairbanks, Morse & Co.
Mietz Machine Works, August.
Standard Motor Construction Co.
Winton Engine Works.
Wolverine Motor Works.

Ladders.
Irving Iron Works Co.
Universal Safety Tread Co.

Ladder Treads.
Irving Iron Works Co.
Universal Safety Tread Co.

Lamps, Signals and Fixtures.
General Electric Co.
Sands, A. B., & Son Co.

Lathe Dogs.
Williams & Co., J. H.

Lathes, Crank Shaft, Engine and Turret.
Greenfield Tap & Die Corp.
Niles-Bement-Pond Co.

Launches and Yachts.
(See Shipbuilders.)

Launching Grease.
Moore Oil Co.
Sun Co.
Texas Co., The.

Lavatories.
(Stateroom.)
Crane Co.
Mott Iron Works, J. L.
Sands, A. B., & Son Co.

Lavatory and Bath Heaters.
Griscom-Russell Co.
Sands, A. B., & Son Co.

Lead Pencils.
(See Drawing Pencils.)

Leather Belting.
Graton & Knight Mfg. Co.

Life Boats and Rafts.
American Balsa Co.
American Ship Building Co.
Galbraith, C. C., & Son.
General Shipbuilding Co.
Lane Life Boat Co., C. M.
McNab Co., The.
Neptune Boat Works.
Westville Boat Building Co.

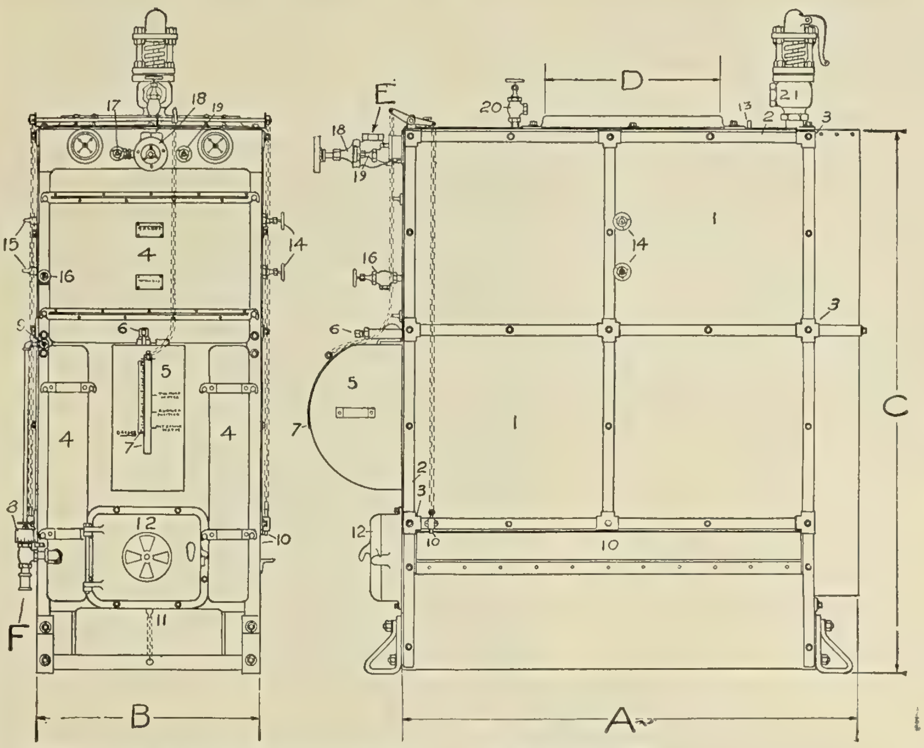
Life Preservers.
American Balsa Co.
Ferdinand, L. W., & Co.
Galbraith, C. C., & Son.

Life-Saving Devices.
American Balsa Co.
Eckliff Circulator Co.
Galbraith, C. C., & Son.
Steward Davit & Equipment Corp.

Lighting Sets.
(See Electric Plants.)

Lights, Electric.
(See Electric Lights.)

Lines—Towing, Buoy.
(See Rope.)



Standard Talbot Boilers

Description & Specifications

(1) Jacket pannels are galvanized sheet steel.

(2) Finishing strips re-enforce edges of Jacket pannels and clamp same in position by ⅜" cap screws spaced about 12" centers.

(3) Finishing clips hold ends of finishing strips making Jacket pannels quickly removable. Boiler is lagged with 2" of insulating material making a cool Jacket.

(4) Tube doors quickly removable on front of boiler permit tubes to be quickly renewed. The tubes being single ended. The free ends being flattened for a wrench permitting the tubes to be unscrewed and drawn into fire room. Any tube may be renewed in 5 or 10 minutes without cooling the boiler down. See Navy Tests.

(5) Regulator shield quickly removable for repairing regulator parts which consist of a heavy pressure plug cock easily reground and adjustably connected to one of boiler tubes by levers which open and close plug cock by expansion and contraction.

(6) Tube adjusting screw to adjust opening of regulator plug cock instantly changing temperature of steam as desired.

(7) Scale and slot in regulator shield which shows position of regulator plug cock and represent the temperature of steam being delivered. Acts and looks like water in water-glass of ordinary boiler but is more reliable and accurate.

(8) Hand feed valve which steadies action of automatic plug cock regulator valve.

(9) By-pass valve—an independent feed valve permitting boiler to be filled when cold.

(10) Side dampers operated by automatic regulator permitting cold air to enter furnace above grates on coal burners and shutting off the air under grates. Cooling tubes and killing fire.

(11) Ash pan cleaning door.

(12) Fire door.

(13) Thermometer Well.

(14) Soot Blower valves.

(15) Soot Blowers built in and operated from outside of boiler effectively sweep all soot from economizer and boiler tubes.

(16) Separator drain valve.

(17) Stack jet valve for temporary forced draft.

(18) Talbot main stop valve.

(19) Talbot auxiliary stop valve.

(20) Whistle stop valve.

(21) Talbot safety valve.

MAY WE SEND YOU OUR BULLETIN "E"?

TALBOT ENGINEERING CORPORATION, 66 Broadway, New York

Linoleum Cement.
Ferdinand & Co., L. W.

Liquid Glue, Waterproof.
Ferdinand, L. W., & Co.

Loading and Unloading Equipment.
(See Freight Handling Equipment.)

Locks and Latches.
(See Ship Locks and Latches.)

Locomotive Cranes.
(See Cranes.)

Log Registers.
American Balsa Co.
Hand, John E., & Sons Co.
McNab Co., The.

Lubricants.
Cook's Sons, Adam.
Dixon, Jos., Crucible Co.
Moore Oil Co.
Sun Co.
Texas Co., The.

Lubricating Compound.
Cook's Sons, Adam.
Moore Oil Co.

Lubricating Strainers.
Schutte & Koerting Co.

Lubricators.
Cook's Sons, Adam.
Crane Co.
Griscom-Russell Co.
Lunkenheimer Co.
Powell, Wm., Co.
Richardson-Phenix Co.
Sun Co.
Williams Valve Co., D. T.

Lumber.
Long-Bell Lumber Co.

Machinists.
Hanna Engineering Works.

Machine Guards.
Page Steel & Wire Co.

Machine Tools.
Cleveland Pneumatic Tool Co.
Cleveland Punch & Shear Works Co.
Greenfield Tap & Die Corp.
McCabe Mfg. Co.
Niles-Bement-Pond Co.
Ryerson, Joseph T., & Son.
Scully Steel & Iron Co.

Manganese Bronze Castings.
American Manganese Bronze Co.
Griscom-Russell Co.
Hyde Windlass Co.
Lunkenheimer Co.
Powell Co., The Wm.

Magnesia Goods and Materials.
Magnesia Association of America.

Malleable and Steel Castings.
Crane Co.
Malleable Iron Fittings Co.

Mandrels.
Pratt & Whitney Co.

Manila and Sisal Rope.
(See Rope.)

Manifolds.
Cleveland Pneumatic Tool Co.
Kerr Machinery Corp.

Manufacturing Plants.
(See Builders.)

Marine Cableways.
Lidgerwood Mfg. Co.

Marine Coatings.
(See Anti-Rust Coatings.)

Marine Copper Work.
Badger, E. B., & Sons.

Marine Decking.
(See Decking.)

Marine Electrical Equipment.
(See Electrical Fittings and Supplies.)

Marine Engines.
(See Engines, Propelling.)

Marine Engineers.
(See Engineers, Consulting.)

Marine Forgings.
(See Forgings.)

Marine Gas Producers.
Nelson Blower & Furnace Co.

Marine Glue.
Ferdinand, L. W., & Co.

Marine Hardware.
American Ship Building Co.
American Standard Shipfittings Corp.
Consolidated Shipbuilding Corp.
Ferdinand & Co., L. W.
Rostand Manufacturing Co.
Sands, A. B., & Son Co.
Tiebout, W. & J.
Topping Brothers.
Wilcox, Crittenden & Co.

Marine Heaters.
(See Heaters.)

Marine Intercommunication Equipment.
Horne Mfg. Co.
Klaxon Co.

Marine Lighting Sets.
(See Electric Plants.)

Marine Paint.
(Also see Paint.)
American Bitumastic Enamels Co.
Bituco Mfg. & Chemical Co.
Dixon Crucible Co., Joseph.
du Pont de Nemours & Co., E. I.
International Compositions Co.
Toch Brothers.

Marine Plumbing.
Crane Co.
Mott Iron Works, J. L.
Sands, A. B., & Son Co.

Marine Railway Builders.
Crandall Engineering Co.

Marine Railways.
(See Dry Docks.)

Marine Ranges.
(See Ranges.)

Marine Refrigeration.
See Refrigerating Machinery.)

Marine Repairs.
(See Shipbuilders.)

Marine Shafting.
(See Shafting.)

Marine Specialties.
(See Steam Specialties.)

Marine Superheaters.
Babcock & Wilcox Co.
Badenhousen Co.
Heine Safety Boiler Co.
Locomotive Superheater Co.
Power Specialty Co.
Talbot Engineering Corporation.

Marine Supplies.
Ferdinand, L. W., & Co.
Tiebout, W. & J.

Marine Valves of Every Description.
(See Valves.)

Marine Wiring Devices.
Benjamin Electric Mfg. Co.
Bryant Electric Co.
General Electric Co.
Page Steel & Wire Co.

Masts, Steel.
Welin Marine Equipment Co.

Masts—Tubular Steel.
National Tube Co.

Mattresses.
Bernstein Manufacturing Co.
Foster Bros. Mfg. Co.
Southern-Rome Co.

Mechanical Draft.
Steam Motors Co.
Sturtevant Co., B. F.

Mechanical Telegraphs.
Chadburn (Ship) Telegraph Co.
Horne Mfg. Co.
Marconi Wireless Telegraph Co.
McNab Co., The.

Metal Slitting Saws.
Morse Twist Drill & Machine Co.

Metallic Packing.
(Also see Packing.)
Allen & Simmonds, Ltd.
Crane Packing Co.
France Packing Co.
Martell Packings Co.
U. S. Metallic Packing Co.

Meters, Electric.
General Electric Co.
Weston Electrical Instrument Co.

Milling Machines.
Greenfield Tap & Die Corp.
Niles-Bement-Pond Co.

Mineral Wool.
(See Non-Conducting Covering.)

Mooring Engines.
American Engineering Co.
Dake Engine Co.
Flory, S., Mfg. Co.
Hyde Windlass Co.
Lidgerwood Mfg. Co.
Mundy, J. S., Hoisting Engine Co.
National Hoisting Engine Co.

Mooring Fixtures.
Central Foundry Co.

Mooring Ports and Rings.
Central Foundry Co.

Motor Boats.
(See Launches and Yachts.)

Motor Boat Supplies.
Ferdinand, L. W., & Co.
Tiebout, W. & J.
Topping Brothers.

Motors, Electric.
Fairbanks, Morse & Co.
General Electric Co.

Motors, Gasoline.
(See Gasoline Engines.)

Motors, Steam.
Steam Motors Co.

Multiple Drills.
Niles-Bement-Pond Co.

Multiple Punches.
Cleveland Punch & Shear Works Co.
Hilles & Jones Co.
Niles-Bement-Pond Co.
Thomas Spacing Mch. Co.

Multiwhirl Oil Coolers.
Griscom-Russell Co.

Nails.
Larkin, J. K., & Co.
Malleable Iron Fttings Co.
Page Steel & Wire Co.

Nautical Instruments.
Hand, John E., & Sons Co.
McNab Co., The.
Sperry Gyroscope Co.

Naval Architects.
Bogert, John L.
Brenzinger, A. H.
Churchill & MacLeod.
Cox & Stevens.
Donnelly, W. T.
Ferris, Theodore.
Gielow & Orr.
Haight, Robert S.
Harris, Leonard B.
Hough, Edward S.
Johnson, Arthur F.
Lysholm, Henry.
Young, Benj. P.

Needle Valves.
(See Valves.)

Nipples.
Crane Co.
Lunkenheimer Co.

Non-Conducting Coverings.
Magnesia Association of America
Thorsen, P. S., & Co., Inc.

Non-Toppling Blocks.
American Balsa Co.

Nozzles.
(See Hose Nozzles.)

Nuts.
(See Bolts and Nuts.)
Camden Forge Co.
Galbraith, C. C., & Son.
Larkin, J. K., & Co.
Russell, Burdsall & Ward Bolt & Nut Co.
Topping Brothers.

Oakum.
American Balsa Co.
American Manufacturing Co.
American Standard Shipfittings Corp.
Galbraith, C. C., & Son.
Stratford Oakum Co., George.

Oil.
(See Lubricants.)

Oil Burners, Fuel.
(See Fuel Oil Burners.)

Oil Burning Equipment.
Kinney Manufacturing Co.
Pneumercator Co.
Schutte & Koerting Co.
Talbot Engineering Corporation

Oil Coolers.
Griscom-Russell Co.
Schutte & Koerting Co.

Oil Cups.
Cook's Sons, Adam.
Crane Co.
Griscom-Russell Co.
Lunkenheimer Co.
Powell Co., The Wm.
Richardson-Phenix Co.
Sun Co.
Williams Valve Co., D. T.

Oil Engines.
(See Engines, Oil.)

Oil Fuel.
Sun Co.
Texas Co., The.

Oil Fuel Apparatus.
(See Oil-Burning Equipment.)

Oil Furnaces.
American Shop Equipment Co.
Metals Production Equipment Co.

Oil Heaters and Coolers.
Griscom-Russell Co.
Ross Heater & Manufacturing Co.
Row & Davis.
Schutte & Koerting Co.

Oil Gauges.
Crane Co.
Lunkenheimer Co.
Powell Co. The William.
Union Water Meter Co.

Oil Pumps.
Cameron Steam Pump Wks., A. S.
Blackmer Rotary Pump Co.
Davidson Co., M. T.
Dean Bros. Steam Pump Works.
Epping-Carpenter Pump Co.
Kinney Mfg. Co.
Lunkenheimer Co.
Powell Co., The Wm.
Ross Heater & Manufacturing Co.
Steam Motors Co.
Sands, A. B., & Son Co.
Terry Steam Turbine Co.
Worthington Pump & Mach. Corp.

Oil Purifiers.
De Laval Separator Co.
Griscom-Russell Co.
Schutte & Koerting Co.

Oil Tanks.
(See Fuel Oil Tanks.)

Oil Tankers.
(See Tank Ships.)

Oiling Systems.
(Also see Lubricants.)
Cook's Sons, Adam.
Lunkenheimer Co.
Powell Co., Wm.
Richardson-Phenix Co.

Ore-Handling Machinery.
(See Coal Handling Machinery.)

Oxy-acetylene Welding and Cutting.
Davis-Bournonville Co.
General Welding & Equipment Co.
Oxweld Acetylene Co.
Prest-O-Lite Co.
Scully Steel & Iron Co.
Torchweld Equipment Co.
Vulcan Iron Works, Inc.

Oxygen.
Davis-Bournonville Co.
Linde Air Products Co., The.
Oxweld Acetylene Co.
Prest-O-Lite Co.

Packing.
(Also see Metallic Packing and Ammonia Packing.)
Albion Mfg. Co.
Allen & Simmonds, Ltd.
Crane Packing Co.
France Packing Co.
General Asbestos & Rubber Co.
Johns-Pratt Co.
Martell Packings Co.
New York Belting & Packing Co.
U. S. Metallic Packing Co.

Packing, Asbestos.
Crane Co.
General Asbestos & Rubber Co.

Packings, Leather.
Watson-Stillman Co.

Paint.
American Bitumastic Enamels Co.
Bituco Mfg. & Chemical Co.
Dixon, Jos., Crucible Co.
du Pont de Nemours & Co., E. I.
International Compositions Co.
Texas Co., The.
Toch Brothers.

Paint Spraying Equipment
(See Pneumatic Paint Spraying Equipment.)

Panel Boards.
(Marine.)
Benjamin Electric Mfg. Co.

Paneling.
(Marine Fireproof.)
Marine Decking & Supply Co.

Parafine Dressing.
Ambrine Laboratories.

Partitions.
(Marine Fireproof.)
Marine Decking & Supply Co.

Patch Bolts.
Scully Steel & Iron Co.
Topping Brothers.

Pencils.
(See Drawing Pencils.)

Phosphor Bronze Castings.
American Manganese Bronze Co.
Griscom-Russell Co.
Hyde Windlass Co.
Lunkenheimer Co.

Pile Drivers.
Flory, S., Mfg. Co.
Lidgerwood Manufacturing Co.
McMyler-Interstate Co., The.
Mundy Hoisting Engine Co., J. S.

Pipe.
American Spiral Pipe Works.
Byers Co., A. M.
Larkin, J. K., & Co.
National Tube Co.
Watson-Stillman Co.

Pipe Bending Machines.
Am. Pipe Bending Machine Co.
Badger, E. B., & Sons.
Buffalo Forge Co.
Curtis & Curtis Co.
Greenfield Tap & Die Corp.
Watson-Stillman Co.

Pipe Covering.
(See Non-Conducting Covering.)

Pipe Cutting and Threading Machines.
Curtis & Curtis Co.
Greenfield Tap & Die Corp.
Niles-Bement-Pond Co.

Pipe Expanding and Flanging Machines.
Lovekin Pipe Expanding and Flanging Mch. Co.
Watson-Stillman Co.

Pipe Flanges.
(See Flanges.)

Pipe Unions.
Crane Co.
Dart, E. M., Mfg. Co.
Lunkenheimer Co.
Powell Co., The, Wm.
Williams Valve Co., D. T.

Pipe Welding.
Metal & Thermit Corporation.

Pipe Wrenches.
Greenfield Tap & Die Corp.
Williams & Co., J. H.

Piston Rings.
(See Packings.)

Piston Rods.
Heppenstall Forge & Knife Co.
Pacific Construction & Engineering Co.

Planers.
(Metal Working.)
Cleveland Pneumatic Tool Co.
Lynd-Farquhar Co.
Niles-Bement-Pond Co.
Scully Steel & Iron Co.

Planers.
(Wood.)
Shipbuilders' Pneumatic Tool Co.

Planimeters.
American Steam Gauge & Valve Mfg. Co.

Plate-Bending Rolls.
(See Rolls, Bending & Straightening.)

Plate and Angle Heating Furnaces.
American Shop Equipment Co.
Metals Production Equip. Co.
Scully Steel & Iron Co.

Plate Cleaning Machines.
Rotary Scraper Co.

Plate Castors.
(See Castors.)

Plate Punch Tables.
Norbom Engineering Co.
Thomas Spacing Machine Co.

Plates.
(See Steel Plates and Shapes.)

Plugs and Receptacles—Watertight.
Benjamin Electric Mfg. Co.
Horne Mfg. Co.

Plumbago.
(Also see Graphite.)
Dixon, Jos., Crucible Co.

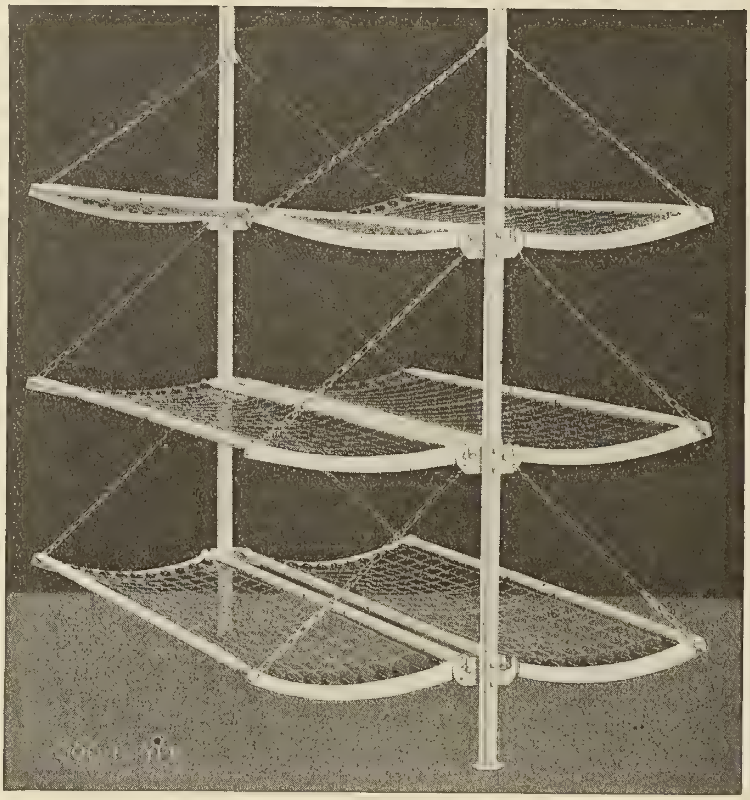
Plumbing.
(See Marine Plumbing.)

Plunger Pumps for Oil Burning Equipment.
Kinney Mfg. Co

Pneumatic Drills.
(See Pneumatic Tools.)

Pneumatic Hammers.
(See Pneumatic Tools.)

Pneumatic Hose.
(See Air Hose.)
Sands, A. B., & Son Co.



Pneumatic Paint Spraying Equipment.
Spray Engineering Co.

Pneumatic Riveters.
Ingersoll-Rand Co.
Oldham, Geo. & Son Co.
Watson-Stillman Co.

Pneumatic Separators.
Griscom-Russell Co.

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Cleveland Pneumatic Tool Co.
Chicago Pneumatic Tool Co.
Duntley-Dayton Co.
Independent Pneumatic Tool Co.
Ingersoll-Rand Co.
Keller Pneumatic Tool Co.
Oldham, Geo., & Son Co.
Scully Steel & Iron Co.

Pop Safety Valves.
American Steam Gauge & Valve Manufacturing Co.
Ashton Valve Co.
Crane Co.
Dew Valve Co.
Lunkenheimer Co.
Powell Co., The Wm.

Poppet Valves.
(See Valves.)

Portable Drills.
General Electric Co.
Lynd-Farquhar Co.

Port Lights.
(See Air Ports.)

Power Hammers.
Chambersburg Engineering Co.

Power Punches.
Watson-Stillman Co.

Power Punches and Shears.
Buffalo Forge Co.
Cleveland Punch & Shear Works Co.
Niles-Bement-Pond Co.
Norbom Engineering Co.
Scully Steel & Iron Co.

Power Riveters.
Cleveland Punch & Shear Works Co.
Independent Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham, Geo., & Son Co.
Scully Steel & Iron Co.
Watson-Stillman Co.

Power Shears.
Buffalo Forge Co.
Cleveland Punch & Shear Works Co.
Niles-Bement-Pond Co.
Quickwork Co., The.
Scully Steel & Iron Co.

Presses.
(See Hydraulic Presses.)

Pressure Regulators.
Ashton Valve Co.
Crane Co.
Lunkenheimer Co.
Mason Regulator Co.
Powell Co., Wm.
Schutte & Koerting Co.

Professional Cards.
Bogert, John L.
Brenzinger, A. H.
Churchill & MacLeod.
Ferris, Theodore.
Haight, Robert S.
Harris, Leonard B.
Hough, Edward S.
Johnson, Arthur F.
Lysholm, Henry.
Nilson, Leonard J.
Young, B. P.

Projectors.
(See Searchlights.)

Propeller Wheels.
American Manganese Bronze Co.
American Screw Propeller Co.
Consolidated Shipbuilding Corp.
Donnelly, W. T.
Great Lakes Engineering Works.
Hardie-Tynes Manufacturing C.
Hyde Windlass Co.
Kearfott Engineering Co.
Kerr Machinery Corp.
Sheriffs Mfg. Co.
Trout, H. G., Co.

Pump Governors.
Mason Regulator Co.
Schutte & Koerting Co.

Pumping Machinery.
(See Engines, Pumping.)

Pumps.
Alberger Pump & Condenser Co.
Blackmer Rotary Pump Co.
Buffalo Steam Pump Co.
Cameron Steam Pump Wks., A. S.
Chambersburg Engineering Co.
Davidson, M. T., Co.
Dean Brothers Steam Pump Wks.
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Fairbanks, Morse & Co.
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Westinghouse Electric & Mfg. Co.
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(See Power Punches.)

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Cleveland Steel Tool Co.
Pratt & Whitney Co.
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Hanna Engineering Works.

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(See Power Punches and Shears.)

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(See Spacing Tables.)

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Bryant Electric Co.
Edwards & Co.

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Locomotive Superheater Co.
Taylor Instrument Companies.

Quadrant Davits.
(See Davits.)

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Kilbourne & Clark Mfg. Co.
Livingston & Co., J.
Marconi Wireless Telegraph Co. of America.

Radial Drills,
Cleveland Punch & Shear Works Co.
Lakeside Bridge & Steel Co.
Lynd-Farquhar Co.
Scully Steel & Iron Co.

Rafts.
(See Lifeboats and Rafts.)

Railway Dry Docks.
Crandall Engineering Co.

Range Finders.
Ranges.
McNab Co., The.

Rasps.
Nicholson File Co.

Ratchet Jacks.
(Pulling and Pushing.)
Gracey & Sons Co., R.

Reamers.
Brubaker & Bros., W. L.
Chicago Pneumatic Tool Co.
Greenfield Tap & Die Corp.
Independent Pneumatic Tool Co.
Morse Twist Drill & Machine Co.
Norbom Engineering Co.
Pratt & Whitney Co.
Rich Tool Co.
Scully Steel & Iron Co.
United States Electrical Tool Co.
Whitman & Barnes Mfg. Co.

Reaming Machines.
Lakeside Bridge & Steel Co.

Recording Instruments.
(Also see Steam Gauges.)
Taylor Instrument Companies.

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(See Gears.)

Reducing Valves.
Crane Co.
Lunkenheimer Co.
Mason Regulator Co.
Schutte & Koerting Co.
Talbot Engineering Corporation.

Reflex Water Gauges.
Jerguson Gage & Valve Co.

Refrigerating Machinery.
Brunswick Refrigerating Co.
Frick Company.
Griscom-Russell Co.
Kroeschell Bros. Ice Machine Co.
Refrigeration Engineering Co.
Remington Machine Co.
Roelker, H. B.
Westinghouse Electric & Mfg. Co.
York Manufacturing Co.

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Crane Co.
Lunkenheimer Co.
Mason Regulator Co.
Powell Co., The Wm.
Sands, A. B., & Son Co.
Schutte & Koerting Co.
Union Water Meter Co.

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American Steam Gauge & Valve Mfg. Co.
Ashton Valve Co.
Crane Co.
Dew Valve Co.
Lunkenheimer Co.
Powell Co., The Wm.
Schutte & Koerting Co.
Watson-Stillman Co.

Revolution Counters.
American Steam Gauge & Valve Mfg. Co.
Ashton Valve Co.
Chadburn (Ship) Telegraph Co.
Electric Tachometer Co.
McNab Co., The.

Rheostats.
General Electric Co.

Rigging.
(See Rope; also Wire Rope.)

Riggers' Blocks.
Terry Manufacturing Co., Ed. F.

River Boats
(See Shipbuilders.)

Rivets.
American Flexible Bolt Co.
Carlin, Anthony.
Champion Rivet Co.
Larkin, J. K., & Co.
Scully Steel & Iron Co.
Severance Mfg. Co., S.
Topping Brothers.

Riveters.
(See Pneumatic Riveters and Power Riveters.)

Rivet Busters, Rivet Clamps and Rivet Tongs.
Chicago Pneumatic Tool Co.
Duntley-Dayton Co.
Ingersoll-Rand Co.
Topping Brothers.
Vulcan Tool Mfg. Co.

Rivet Heating Furnaces.
American Shop Equipment Co.
Metals Production Equipment Co.

Rivet Sets.
Cleveland Steel Tool Co.
Rich Tool Co.
Scully Steel & Iron Co.
Topping Brothers.

Riveting Machines, Hydraulic and Steam Power.
(Also see Power Riveters and Pneumatic Riveters.)
Chambersburg Engineering Co.
Chicago Pneumatic Tool Co.
Hanna Engineering Works.
Independent Pneumatic Tool Co.
Niles-Bement-Pond Co.
Scully Steel & Iron Co.

Riveters, Pneumatic.
(See Power Riveters.)

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Carnegie Steel Co.
General Steel Co.

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Roller Bearings.
Bantam Ball Bearing Co.
Gwilliam Co., The.

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Heppenstall Forge & Knife Co.
Niles-Bement-Pond Co.
Scully Steel & Iron Co.

Roofing, Fireproof.
Texas Co., The.

Roofing Paints.
Dixon, Joseph, Crucible Co.
Ferdinand, L. W., & Co.
International Compositions Co.

Rope.
(Also see Wire Rope.)
American Manufacturing Co.
Columbian Rope Co.
Durable Wire Rope Co.
Granger, Geo. B., & Co.
Leschen & Sons, A., Rope Co.
McNab Co., The.
Moon Co., Geo. C.
Plymouth Cordage Co.
Samson Cordage Works.
Waterbury Co.
Whitlock Cordage Co.

Rope Transmission.
American Manufacturing Co.
Columbian Rope Co.
Whitlock Cordage Co.

Rotary Blowers.
(See Blowers.)

Rotating Plunger Pumps.
Kinney Mfg. Co.

Rotary Pumps.
Blackmer Rotary Pump Co.
Kinney Mfg. Co.
Sands, A. B., & Son Co.

Rotary Scrapers.
Rotary Scraper Co.

Rotary Shears.
Quickwork Co., The.

Rowboats.
(See Launches and Yachts.)

Rowlocks.
Malleable Iron Fittings Co.

Rubber Belting.
New York Belting & Packing Co.

Rubber Goods.
(Also see Packing; also see Interlocking Rubber Tiling.)
Goodrich Rubber Co., B. F.
New York Belting & Packing Co.
United States Rubber Co.

Rubber Tiling.
(See Interlocking Rubber Tiling.)

Rudder Posts.
Hardie-Tynes Manufacturing Co.
Mesta Machine Co.
Pacific Construction & Engineering Co.

Rudder Stocks and Arms.
American Manganese Bronze Co.
Camden Forge Co.
Hardie-Tynes Manufacturing Co.
Heppenstall Forge & Knife Co.
Mesta Machine Co.
Pacific Construction & Engineering Co.

Rust Cleaning Device.
Rotary Scraper Co.

Safety Devices.
(See Life Saving Devices.)

Safety Set Screws
(See Set Screws.)

Safety Valves.
(See Valves.)

Sanitary Fittings.
(See Plumbing.)

Sanitary Pumps.
Davidson Co., M. T.
Dean Bros. Steam Pump Works.
Epping-Carpenter Pump Co.
Morris Machine Works.
Sands, A. B., & Son Co.
Worthington Pump & Mach. Corp.

Saws.
Scully Steel & Iron Co.

Scales—All Kinds.
Fairbanks, Morse & Co.

Scarphing Machines.
Skinner & Eddy Corp.

Scraping Machines.
Rotary Scraper Co.

Screw Cutting Tools and Gauges.
Greenfield Tap & Die Co.

Screw Plates.
Morse Twist Drill & Machine Co.

Screw Punches.
Cleveland Punch & Shear Works Co.,
Scully Steel & Iron Co.

Seamless Steel Tubes.
National Tube Co.

Searchlights.
Benjamin Electric Mfg. Co.
Crouse-Hinds Co.
General Electric Co.
Engberg's Electric & Mechanical Works.
Sperry Gyroscope Co.

Sensitizing Machinery, Blue-Print Paper.
Pease Co., C. F.

Sentinel Valves.
(See Valves.)

Shaft Steel.
(See Steel Shafting.)

Shafting.
(Hollow, Seamless Steel.)
Camden Forge Co.
Hardie-Tynes Manufacturing Co.
Heppenstall Forge & Knife Co.
Kearfott Engineering Co.
Mesta Machine Co.
National Tube Co.
Savage Arms Corporation.
Scully Steel & Iron Co.

Shafting—Bronze.
American Manganese Bronze Co.

Shearing Machines.
(See Power Shears.)

Shears.
(See Power Shears.)

Sheaves.
Hudson Block Co.

Sheet Rubber Tiling.
United States Rubber Co.

Shims.
Laminated Shim Co., The.

Shipbuilders and Dry Dock Companies.
American Balsa Co.
American Ship Building Co.
Ames Shipbuilding & Dry Dock Co.
Ansaldo & C.
Atlantic Corporation, The.
Baltimore Dry Docks & Shipbuilding Co.
Bethlehem Shipbuilding Corp.
Chester Shipbuilding Co.
Columbia Engineering Works.
Consolidated Shipbuilding Corp.
Davis & Son, M. M., Inc.
Fletcher, W. & A., Co.
Foundation Co., The.
General Shipbuilding Co.
Great Lakes Engineering Works.
Groton Iron Works.
Imperial Shipbuilding Corp.
International Navigation Corp.
Johnson Iron Works, Ltd.
McDougall-Duluth Co.
Manitowoc Ship Building Co.
Newport News Shipbuilding & Dry Dock Co.
New London Ship & Engine Co.
Peninsula Shipbuilding Co.
Saginaw Shipbuilding Co.
Seattle North Pacific Shipbuilding Co.
Skinner & Eddy Corp.
Standard Motor Construction Co.
Todd Shipyards Corp.
Union Dry Dock & Repair Co.
Valk & Murdoch Co.
Virginia Shipbuilding Corp.
Vulcan Iron Works, Inc.
Ward, Chas., Engineering Works.

Shipbuilding Cranes.
(See Cranes.)

Ship Brokers.
Bogert, John L.
Brenzinger, A. H.
Cox & Stevens.
Ferris, Theodore.
Haight, Robert S.
Harris, Leonard B.
Hough, Edward S.
Johnson, Arthur F.
Young, Benj. P.

Ship Chandlers.
(See Chandlery Stores.)

Ship Clocks.
(See Clocks.)

Ship Compositions.
American Bitumastic Enamels Co.
Bituco Mfg. & Chemical Co.
International Compositions Co.

Ship Cowls.
(See Cowls.)

Ship Fittings, Supplies and Equipment.
Ferdinand, L. W., & Co.
Griscom-Russell Co.
Topping Brothers.

Ship Glue.
(See Marine Glue.)

Ship Gratings.
Irving Iron Works Co.

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Tiebout, W. & J.
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New Jersey Zinc Co.

Ship Rivets.
(See Rivets.)

Ship Stabilizers.
Sperry Gyroscope Co.

Ship Stores.
(See Chandlery Stores.)

Ship Strainers.
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Chadburn (Ship) Telegraph Co.
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Klaxon Co.

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(See Lumber.)

Ship Upholstery.
Du Pont Fabrikoid Co.

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(See Shipbuilders.)

Shipyard Cranes.
(See Cranes.)

Shipyard Whirlers.
(See Cranes.)

Shop Cranes.
(See Cranes.)

Shop Equipment.
American Shop Equipment Co.

Signaling Apparatus.
Benjamin Electric Mfg. Co.

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Otto & Sons, Inc., Albert.

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Hand, John E., & Son Co.
McNab Co., The.

Southern Pine.
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Terry, Edward F., Co.
Thomas Spacing Mch. Co.

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Electric Tachometer Corp.
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Spikes.
Galbraith, C. C., & Son.
Larkin, J. K., & Co.
Topping Brothers.

Spraying Equipment.
Schutte & Koerting Co.
Spray Engineering Co.

Sprocket Rims.
(See Adjustable Sprocket Rims.)

Stabilizers.
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Stairs and Stair Treads.
Irving Iron Works Co.

Staybolts.
American Flexible Bolt Co.
Scully Steel & Iron Co.

Staybolt Iron.
Burden Iron Co.
Scully Steel & Iron Co.

Staybolt Taps.
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Steam Engines.
(See Engines.)

Steam Gauges.
American Steam Gauge & Valve Mfg. Co.
Ashton Valve Co.
Crane Co.
Horne Mfg. Co.
Lunkenheimer Co.
Powell Co., Wm.
Taylor Instrument Companies.
Williams Valve Co., D. T.

Steam Hammers.
Chambersburg Engineering Co.
Niles-Bement-Pond Co.

Steam Pipe Coverings.
(See Non-Conducting Coverings.)

Steam Pumps.
(See Pumps.)

Steam Separators.
Crane Co.
Griscom-Russell Co.
Schutte & Koerting Co.
Talbot Engineering Corporation.
Williams Valve Co., D. T.

Steam Specialties.
(See Pumps, Valves, Gauges, Lubricators, Etc.)

Steam Superheaters.
(See Marine Superheaters.)

Steam Traps.
American Steam Gauge & Valve Mfg. Co.
Crane Co.
Griscom-Russell Co.
Mason Regulator Co.
Pratt & Cady Co., Inc.
Sands, A. B., & Son Co.
Union Water Meter Co.
Williams Valve Co., D. T.

Steam Turbines
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Bethlehem Shipbuilding Corp.
De Laval Steam Turbine Co.
Fletcher, W. & A., Co.
General Electric Co.
Howden, James, & Co.
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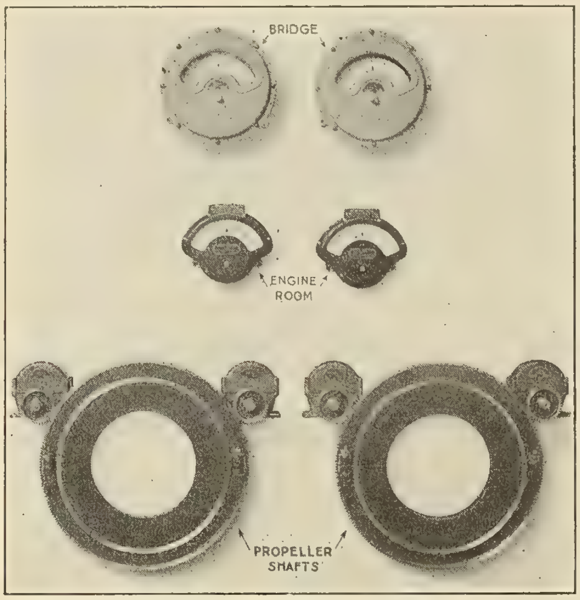

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(See Rolls.)

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(See Electrical Appliances.)

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(See Electric Tachometers.)

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(See Shafting.)

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Pneumercator Co.

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Continental Iron Works, The.
National Tube Co.

Tanks, Welded Steel.
Continental Iron Works, The.

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Irving Iron Works Co.

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Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
Pratt & Whitney Co.
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Whitman & Barnes Mfg. Co.

Tarred Hemp Rope.
Whitlock Cordage Co.

Tees.
Carnegie Steel Co.
General Steel Co.

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Hyde Windlass Co.

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(Also see Ship Telephones.)
Marconi Wireless Telegraph Co. of America.

Test Pumps.
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Thermometers.
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Taylor Instrument Companies.

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Tiling.
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Tools.
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Tool Steel.
Carnegie Steel Co.
Cleveland Steel Tool Co.

Tools, Machine.
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Tool Holders.
Williams & Co., J. H.

Torsion Meters.
McNab Co., The.

Tower Cranes.
Dravo Contracting Co.

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Towing Lines.
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Towing Machines.
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Dake Engine Co.
Lidgerwood Manufacturing Co.

Transmission Rope.
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Traps.
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Traveling Cranes.
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Trolley and Track Systems.
Brown Hoisting Machinery Co
McMyler-Interstate Co.
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Gwilliam Co., The.

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(See Seamless Steel Tubes.)

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Standard Underground Cable Co.

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Durable Wire Rope Co.
Moon Co., Geo. C.
Scully Steel & Iron Co.
Topping Brothers.
Waterbury Co.
Williams & Co., J. H.

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American Engineering Co.

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Samson Cordage Works.
Waterbury Co.
Whitlock Cordage Co.

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Morse Twist Drill & Machine Co.
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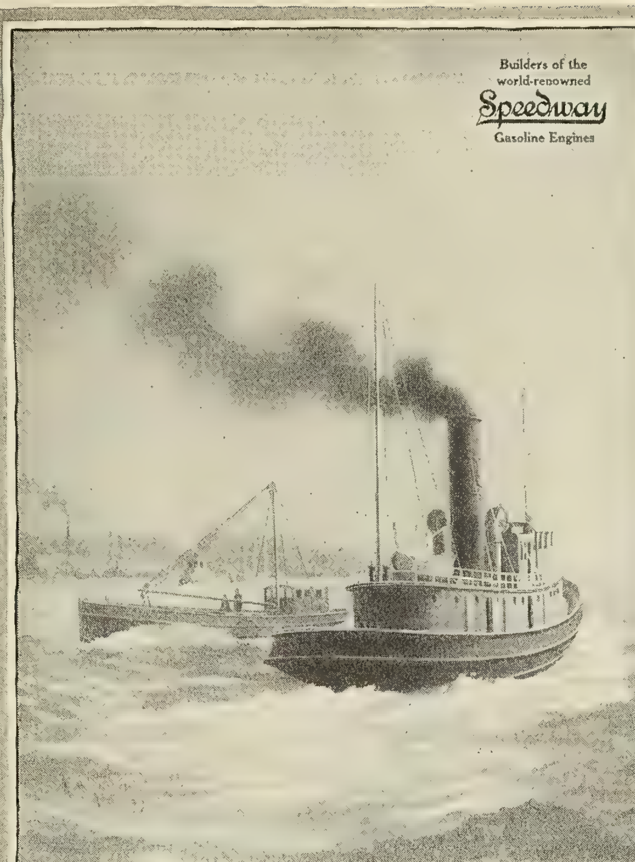

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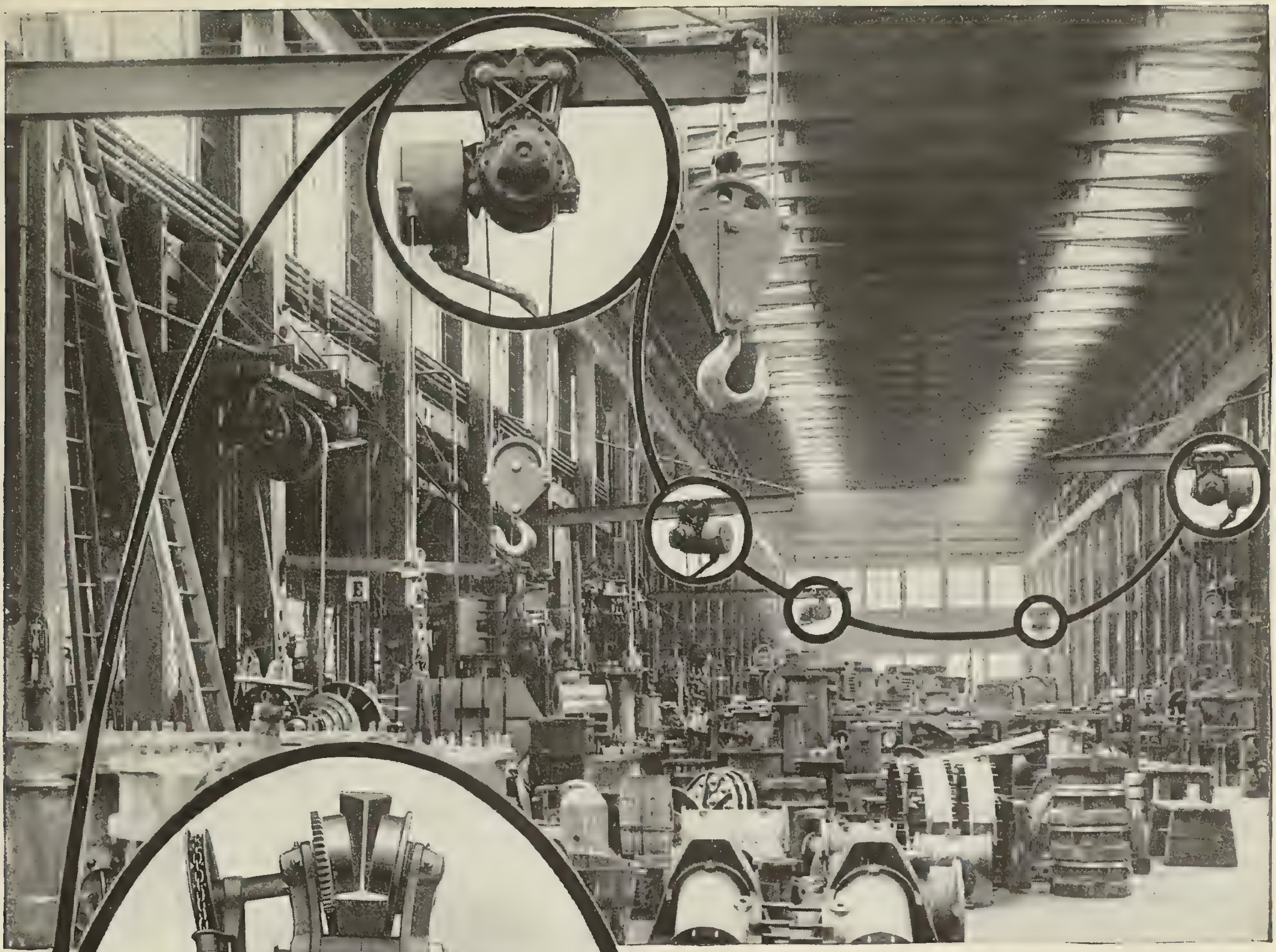

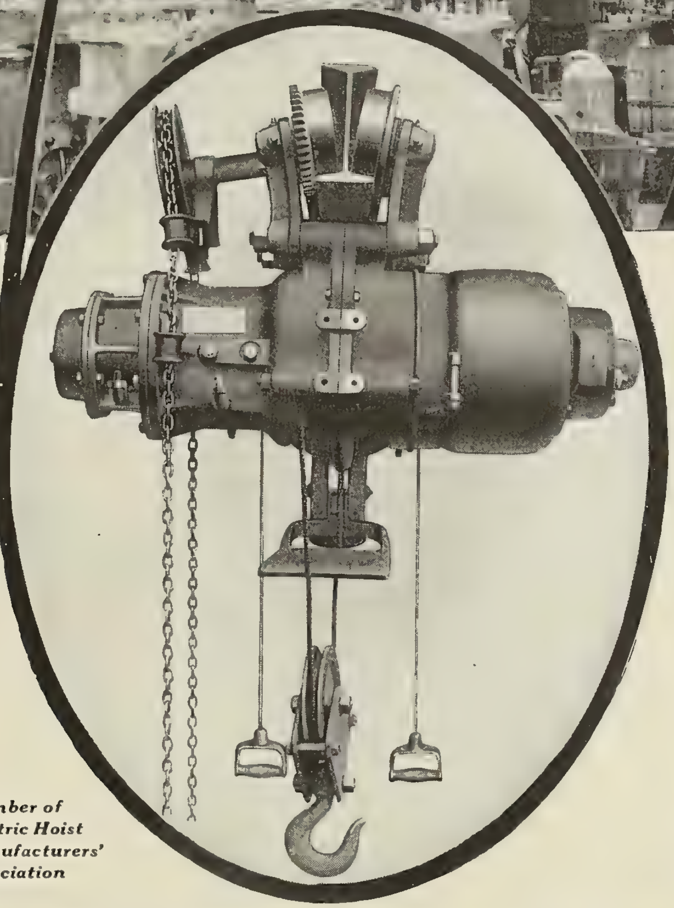

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